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Boone County Field Site Interim Report

Test Cells 2A, 2B, 2C, and 2D

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16. ABSTRACT

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Test Cells 2A, 2B, 2C, and 2D

by

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Purchase Order No. CA-7-2512-A

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FOREWORD

The Environmental Protection Agency was created because of increasing public and government concern about the dangers of pollution to the health and welfare of the American people. Noxious air, foul water, and spoiled land are tragic testimony to the deterioration of our natural environment. The complexity of that environment and the interplay between its components require a concentrated and integrated attack on the problem.

Research and development is that necessary first step in problem solution, and it involves defining the problem, measuring its impact, and searching for solutions. The Municipal Environmental Research Laboratory develops new and improved technology and systems to prevent, treat, and manage wastewater and solid and hazardous waste pollutant discharges from municipal and community sources, to preserve and treat public drinking water supplies, and to minimize the adverse economic, social, health, and aesthetic effects of pollution. This publication is one of the products of that research - a most vital communications link between the researcher and the user community.

The information presented here was gathered from long-term monitoring of four sanitary landfill cells (one field-scale and three small-scale). The cells were constructed to provide an understanding of sanitary landfill behavior, the potential effects on the environment, and the validity of conducting this research with small-scale cells.

Francis T. Mayo
Director
Municipal Environmental research
Laboratory

ABSTRACT

Sanitary landfills presently play a significant role in the disposal of solid wastes, and they will probably continue to do so in many areas because of their economic advantages over other methods. However, justifiable concern exists about the environmental effects of sanitary landfills. The research project described here was undertaken to provide a better understanding of the processes that occur within a sanitary landfill and the related environmental effects.

The initial field-scale test cell was completed in June 1971 and has been monitored since then for temperature, gas composition, settlement, and leachate quantity and characteristics. Four additional cells (2A, 2B, 2C and 2D) were constructed during August 1972. One of these was field-scale (2D), and the others were small-scale cells that simulated the large cell for the purpose of performance comparison. Water input to the cells was controlled, and all cells were monitored for temperature, gas composition, settlement, and leachate quantity and characteristics.

This report was submitted in fulfillment of Purchase Order No. CA-7-2512A by Regional Services Corporation, Inc., under the sponsorship of the U.S. Environmental Protection Agency. The report covers the period August 1972 to December 1976, and work was completed as of February 1978.

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SECTION I

INTRODUCTION

The Boone County Field Site consists of a ten acre tract located 8 km west of the City of Walton, Kentucky, in Boone County. The property is leased from the Northern Kentucky Sanitation Company. Available facilities at the site include an office trailer, a pole barn, and a 27.2 t truck scale. Equipment includes an industrial tractor with a backhoe and front-end loader, a portable power soil auger, a trailer mounted water tank, and miscellaneous tools. An instrumentation shed has been placed near the test cell and a weather station has been erected at the site.

The geologic setting of the site is the northwestern section of the physiographic Interior Low Plateau Province. Elevations at the research site range between 213 and 244 m above sea level. Surficial soils at the site are predominantly a lean clay, classified by the USDA as Nicholson silt loam. Rubbly limestone mixed with thin beds of soft calcareous shales of the Fairview formation underlie the shallow soil. The mean annual precipitation in the area is 927 mm. Monthly normal mean temperatures range from 0°C in January to 24.4°C in July.

The primary objectives of studying test cells 2A, 2B, 2C, and 2D were to:

(1) Analyze the amount and characteristics of leachate.

(2) Analyze the composition of gasses present in the cells.

(3) Analyze temperature conditions and compare these temperatures to the conditions existing in the surrounding soil.

(4) Evaluate settlement of the research cells.

(5) Evaluate construction, monitoring and analytical procedures.

(6) Evaluate the behavior of a field-scale test cell, 2D, as compared to similarly constructed small-scale test cells, 2A, 2B and 2C.

SECTION II

SUMMARY AND CONCLUSIONS

Four sanitary landfill test cells containing municipal solid waste were constructed at the Boone County Field Site during August 1972. Three of the cells, 2A, 2B and 2C were small-scale and the fourth cell, 2D, was constructed similarly to a normal landfill cell. These units were constructed to compare the performance of small-scale systems with a field-scale cell and to evaluate the variations within the three small cells as measured by leachate quantity and characteristics, gas composition and temperature.

The initial refuse composition and moisture in all cells was determined to be statistically similar. In-place refuse densities in the small cells varied from 392-431 kg/m^3. The density in cell 2D was 598 kg/m^3. After precipitation input to all cells of 2050 mm, leachate collected per unit of surface area varied from 213-2347 mm. The low value occurred in 2C and was probably due to a leak from the cylinder side or base. The upper value was collected from 2D and was in excess of precipitation, indicating leakage into the cell from the soil walls. The apparent field capacity of the refuse in all cells was found to be within 10% of values reported in the literature.

Leachate composition histories were statistically compared at intervals of 100 mm of leachate collected using a paired difference test. The statistical test was not adequate, indicating non-similarity where data trends were close and similarity in some instances where graphs showed obvious differences. For most of the parameters studied the concentration histories of 2A and 2B showed similar responses and trends. The histories from 2D characteristically showed a later and lower peak value than in 2A and 2B. Mass removals from 2A and 2B were generally similar and statistically the same on an incremental basis for 9 of 14 parameters. Mass removed per kg of dry refuse from 2D was less than that from 2A and 2B for all parameters examined.

It was not possible to accurately compare gas compositions due to data discontinuities and erratic results. Temperatures were similar among the small-scale cells at the center of the refuse but were not comparable to the temperatures recorded in 2D. Average settlement over the surface of 2D was only half that recorded in the small-scale cells.

The density and leachate volume differences precluded a definitive comparison of the behavior of small and large-scale test cells. The statistical evaluation of the comparative behavior of identically constructed small-scale cells was inconclusive.

SECTION III

RECOMMENDATIONS

Construction and monitoring of test cells 2A, 2B, 2C and 2D have provided significant information on the simulation of field-scale landfill performance. While this interim data analysis and report indicate a lack of statistical similarity among the small-scale cells and in comparison to the field-scale cell, there exists a potential for more accurate definition of any difference through further work with the data and further monitoring of long-term trends. It is suggested that the following recommendations be considered to further this research work:

1. Leachate sampling should be continued from 2A, 2B and 2D, but on a frequency of no more than once per month, for an indefinite period so as to define long-term parameter concentration ranges, contamination potentials and mass removals. Leachate analyses from 2C, if continued, should be done on a quarterly basis. More frequent leachate volume readings from 2D should be obtained in order to delineate the cause of the excessive leachate production.

2. A more applicable statistical measure of similarity should be utilized in future data anlysis, and to the extent possible, all data should be used rather than weighted means. Leachate volumes and concentrations from 2D should be corrected, when the source and quantity of leakage is identified, for any future statistical comparison.

3. The leachate concentration histories and mass removals should be compared to the results from other similar studies so that ranges of expected concentrations and removals over a greater extent of water input rates can be defined. This should be done together with further development of descriptive equations.

SECTION IV

CONSTRUCTION OF TEST CELLS

Four test cells containing municipal solid waste were constructed at the Boone County Field Site during August 1972.(1) Three of the cells, 2A, 2B, 2C, are enclosed in identical cylindrical steel pipes, 1.83 m in diameter and 3.66 m long. The fourth test cell, 2D, is an 8.53 m square field cell constructed similarly to a normal sanitary landfill cell. These units were constructed to compare the performance of small-scale systems with a field-scale landfill cell and to evaluate the variations within the three small cells as measured by leachate quantity and characteristics, gas composition and temperature.

Construction of Cells 2A, 2B, 2C

The steel pipes containing cells 2A, 2B and 2C were constructed of 4.8 mm hot-rolled steel plate coated on both sides with cold tar epoxy 1.5-2.0 mm thick. The pipes were placed vertically in an excavation on 150 mm thick reinforced concrete pads. Each pad contained a trough system with a 51 mm diameter slotted PVC pipe for leachate collection and flow to a central collection well, as shown in Figure 1. After installation of the pipes a 7.6 mm thick concrete overlay was placed around the pipes to prevent lateral movement. A fiberglass coating was applied to the concrete pad inside the pipe and .3 m up the interior walls of the pipe as protection against contact with leachate. The interior of the collection trough was backfilled with silica gravel and then .3 m of silica sand was placed at the bottom of each pipe. Petrographic analyses for the gravel and sand are presented in Table 1. Earth backfill was placed around the exterior of the pipes to within 150 mm of the tops of the pipes.

Refuse was then placed in the pipes in 90-135 kg increments to a total depth of 2.56 m. Each increment was compacted by dropping a 135 kg weight from approximately 1.2 m above the refuse until no further compaction was apparent. Temperature and gas probes were placed within the cell during placement of the refuse as shown in Figures 2 and 3. After refuse placement a 300 mm compacted soil cover from the site was applied. This soil was then covered by 300 mm of pea gravel to allow rapid percolation of rainfall and to minimize evaporation. The construction timetable is presented in Table 2. The relative positions of the cells are shown in Figure 4.

Construction of Cell 2D

Cell 2D was constructed in an excavation 8.53 m square and 3.20 m deep. The base of the cell was then shaped with sand for drainage and a 7.6 mm thick chlorinated polyethylene liner (Staff Industries, Inc.) was placed along

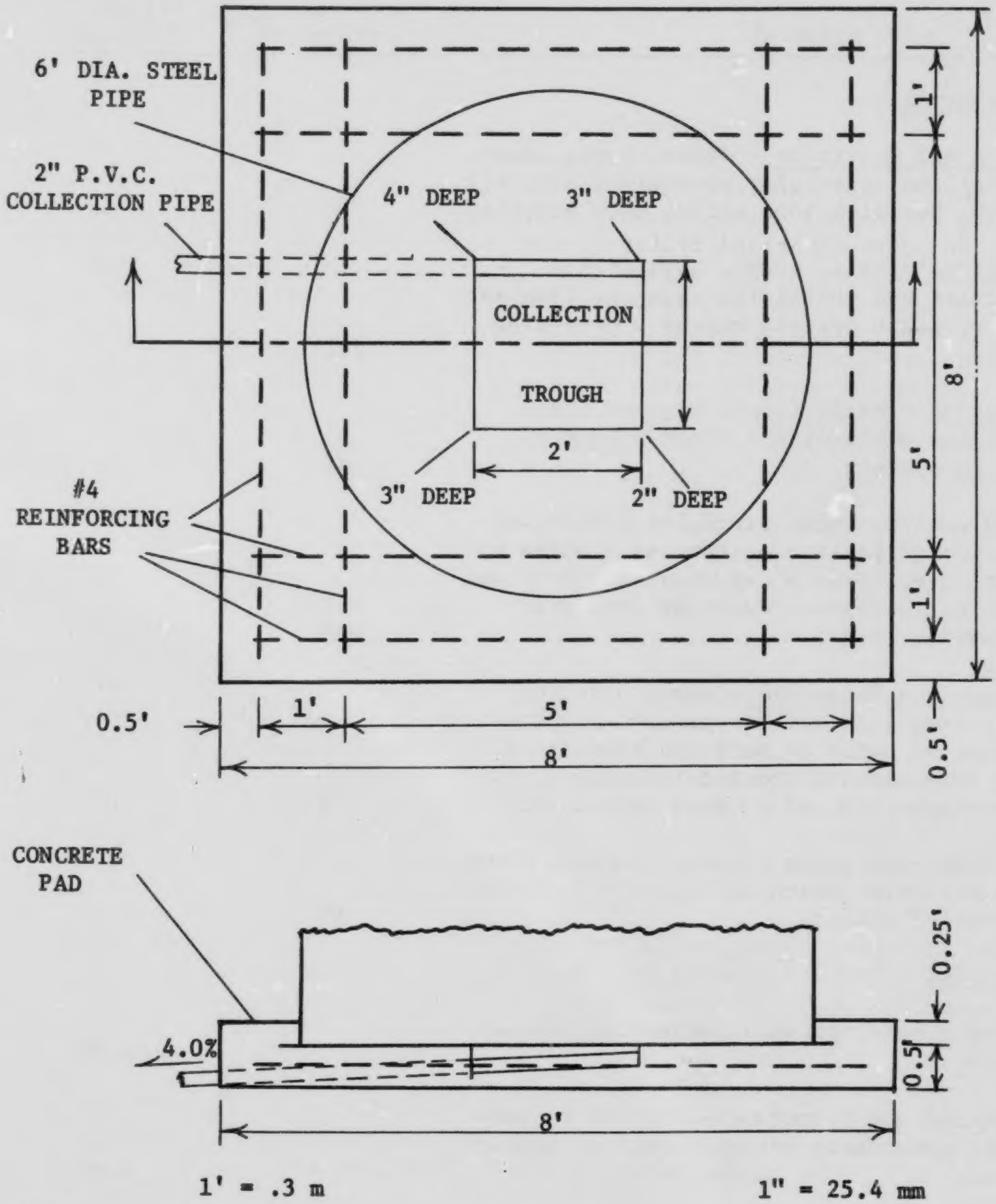


Figure 1. Concrete base and leachate collection system for cells A, B, and C.

TABLE 1. PETROGRAPHIC ANALYSIS OF SILICA SAND AND GRAVEL

Material	Percent by weight	Percent by volume
Gravel Material		
Quartz and Quartzite - dense, hard, tough, crystalline, particles consisting entirely of SiO_2 but with some slight iron staining.	56%	
Sandstone - hard, tough, high-silica particles but containing abundant iron as a heavy stain deposit and/or a cementing agent.	24%	
Sandstone - hard, tough, high-silica particles containing a minor amount of iron as a stain.	3%	
Chert - hard, tough particles consisting of microcrystalline quartz and chalcedony. The chalcedony is about 90 to 99% SiO_2 and minor to moderate amounts of iron and aluminum compounds.	13%	
Igneous and Metamorphic Rocks - dense, hard, tough, crystalline particles which consist of major to moderate amounts of SiO_2 and minor to moderate amounts of ferro-magnesian and alumina compounds.	3%	
Weathered Particles - soft, crumbly, iron-rich particles which may contain moderate amounts of silica.	1%	
Sand Material		
Quartz - hard, tough, crystalline grains of SiO_2.		95.1%
Sandstone and Siltstone - hard tough particles consisting of well-cemented quartz grains.		4.4%
Weathered Sandstone - friable, easily-broken particles consisting of poorly-cemented quartz grains.		0.5%

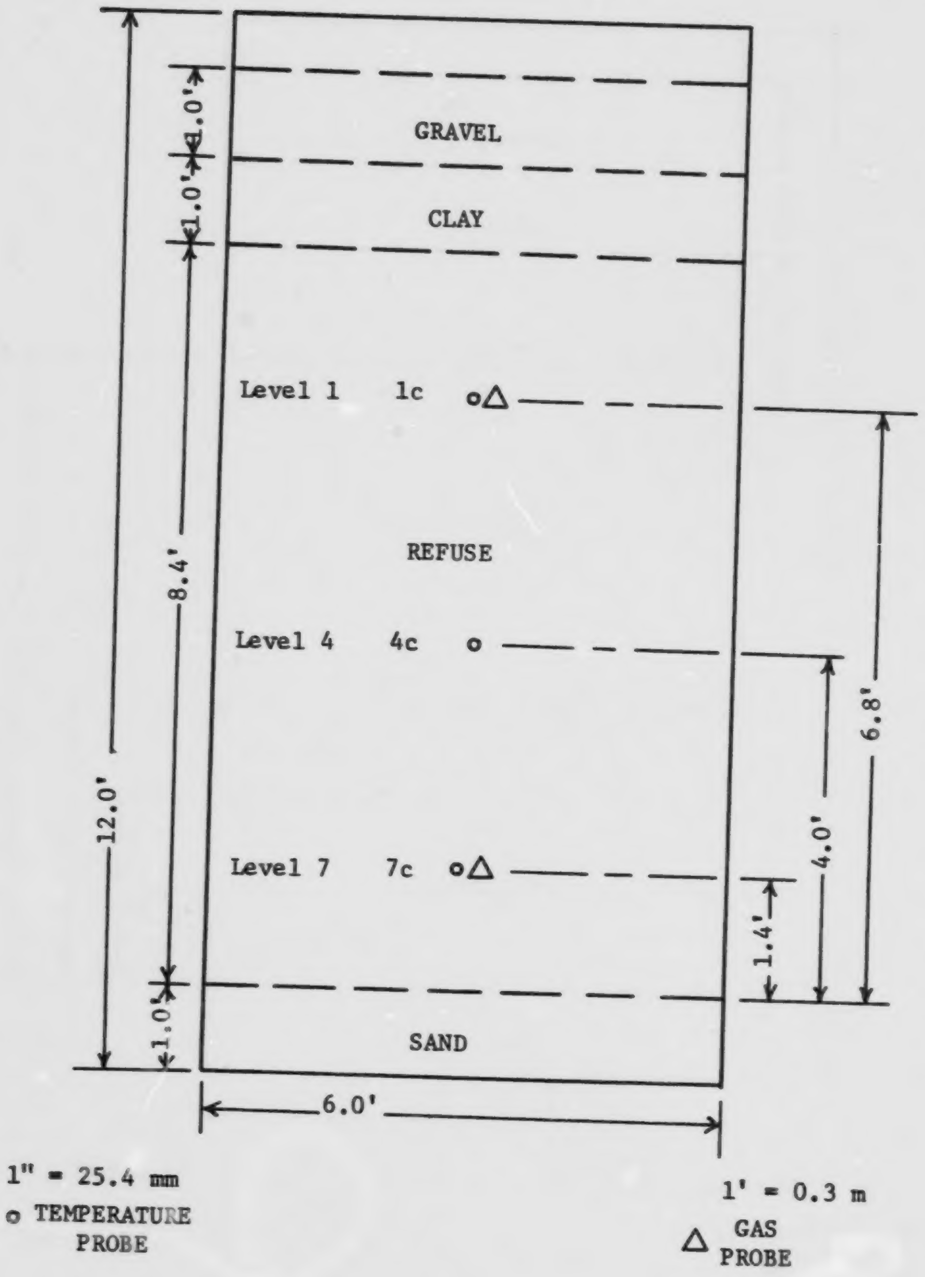


Figure 2. Construction details for cells 2A and 2C.

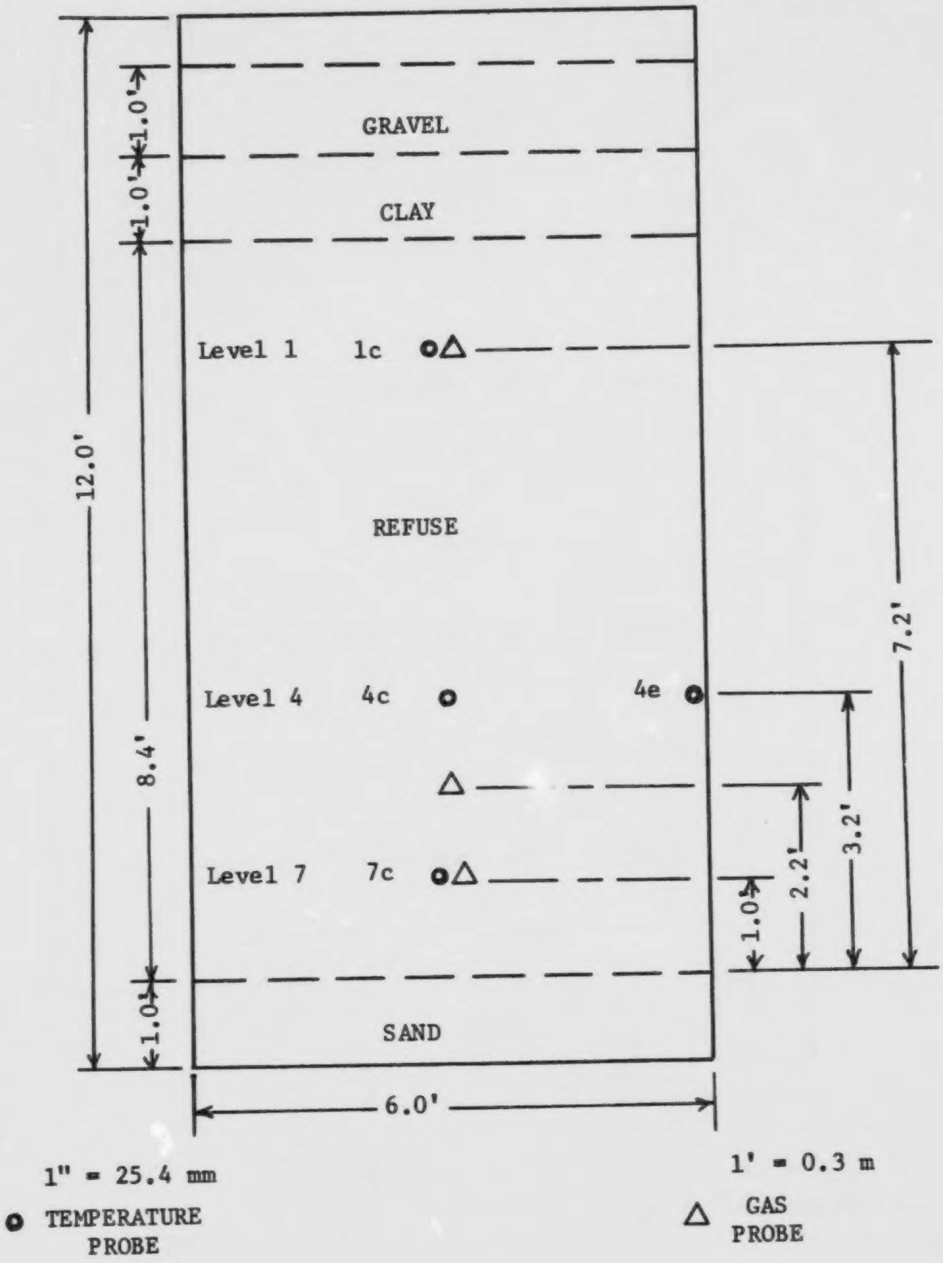
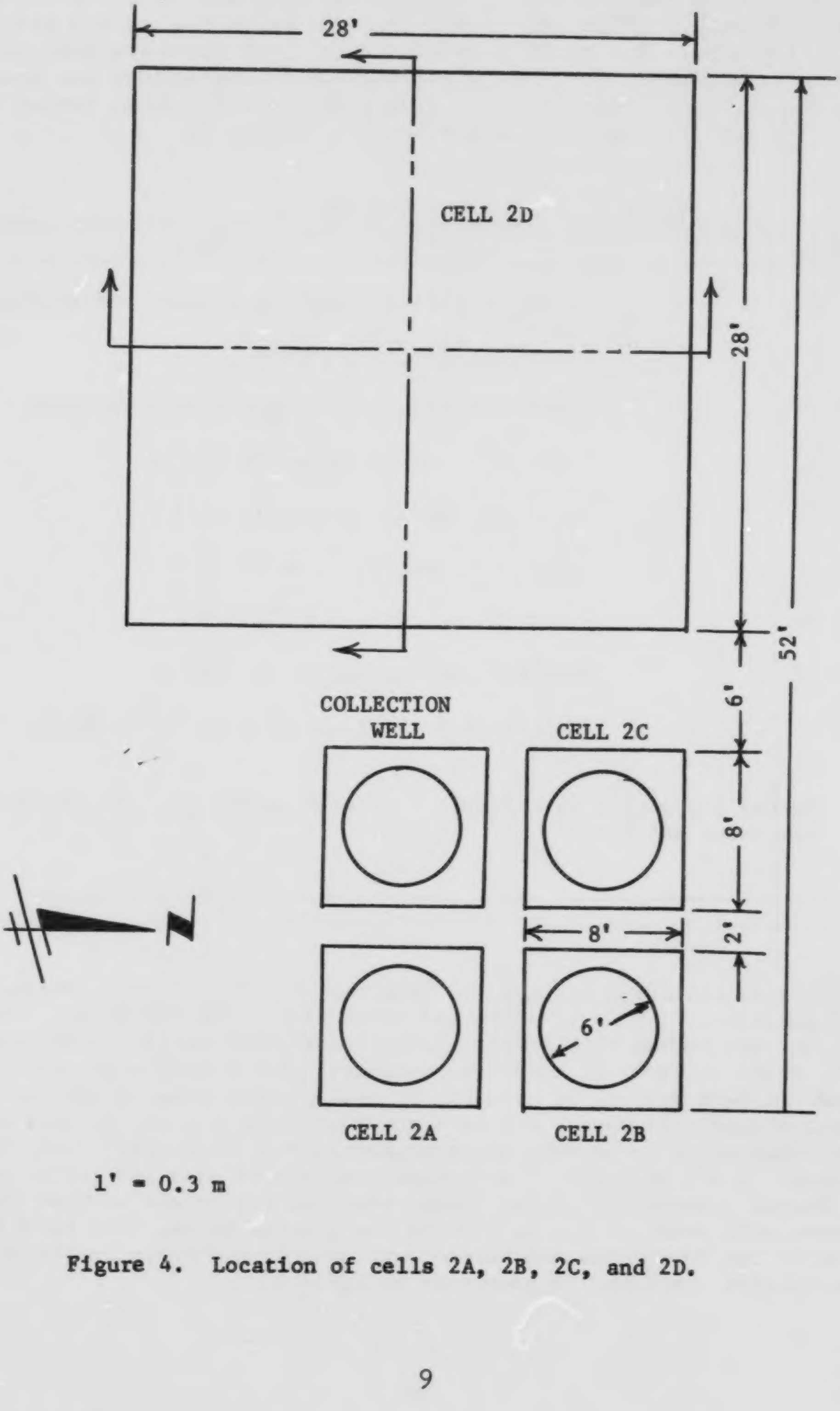


Figure 3. Construction details for cell 2B.



1' = 0.3 m

Figure 4. Location of cells 2A, 2B, 2C, and 2D.

the cell side walls and base. A slotted PVC pipe was placed along the center line of the base of the cell for leachate collection and gravity drainage to the collection well. Silica gravel was then placed on the top and sides of the collection pipe. The entire base of the cell and liner was then covered with 300 mm of silica sand. Plywood sheets were placed against the synthetic liner on the sidewalls for protection from puncture and tearing during cell filling. The construction details are shown in Figure 5.

TABLE 2. CONSTRUCTION TIMETABLE

Date	Operation
August 8	Begin collecting refuse in windrow and stockpile
August 9	Complete collecting refuse
August 10	Samples obtained for compositional analysis
August 12	Place and compact refuse in Cell B
August 14	Place and compact refuse in Cell A
August 15	Place and compact refuse in Cell C
August 16	Start placing refuse in Cell D
August 17	Complete placing refuse in Cell D
August 18	Install clay cover on Cells A, B, C, and D

Note: During the period from August 8 through August 17, the weather was sunny and hot.

A Case 450 bulldozer was lowered into the cell by a crane. Refuse was added by the crane from a stockpile and compacted by the bulldozer. Temperature and gas probes were placed during the filling at locations shown in Figure 5. A 300 mm layer of compacted soil cover was placed over the 2.44 m of refuse. A berm system, as shown in Figure 6, consisting of 150 mm high triangular-shaped clay berms, was hand constructed on top of the soil cover. This was constructed to promote uniform percolation of rainfall into the refuse cell. A 300 mm layer of pea gravel was placed over the entire soil cover. Excess liner material was folded over the top of the plywood sheeting and covered with earth on the outside of the plywood walls. The relative locations of the four cells and the collection well are shown in Figure 4. The construction timetable is presented in Table 2.

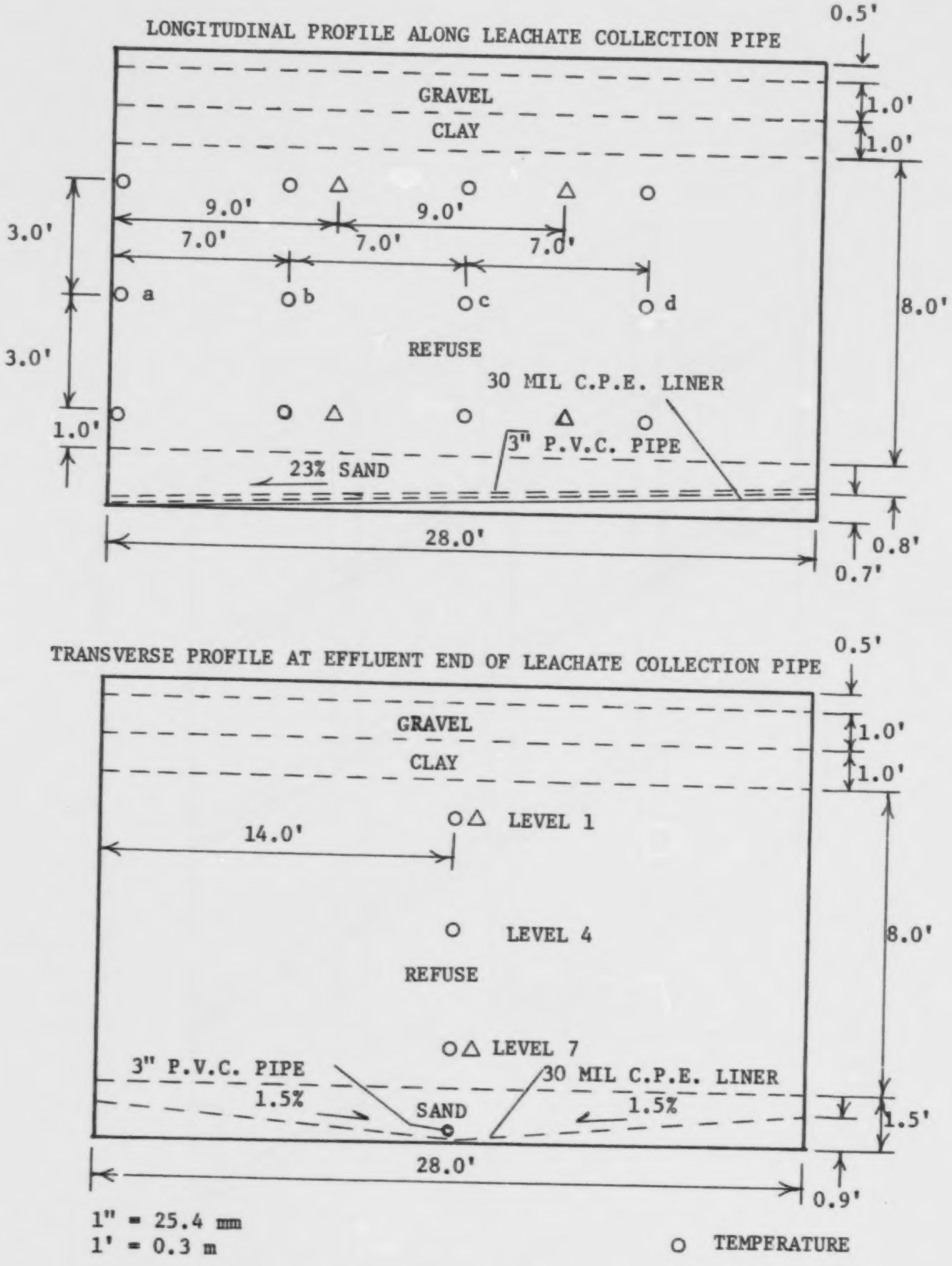


Figure 5. Construction details for cell 2D.

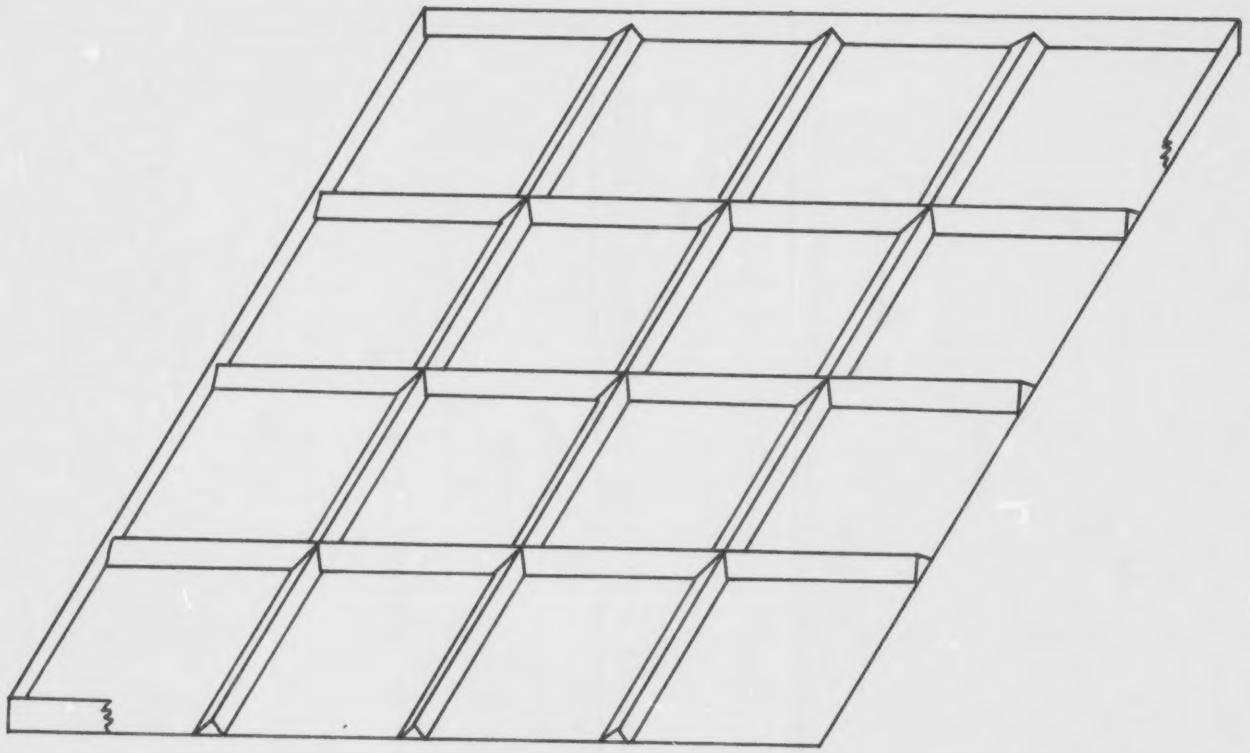


Figure 6. Construction of clay cover for cell 2D

SECTION V

DATA COLLECTION AND ANALYSIS

REFUSE COMPOSITION

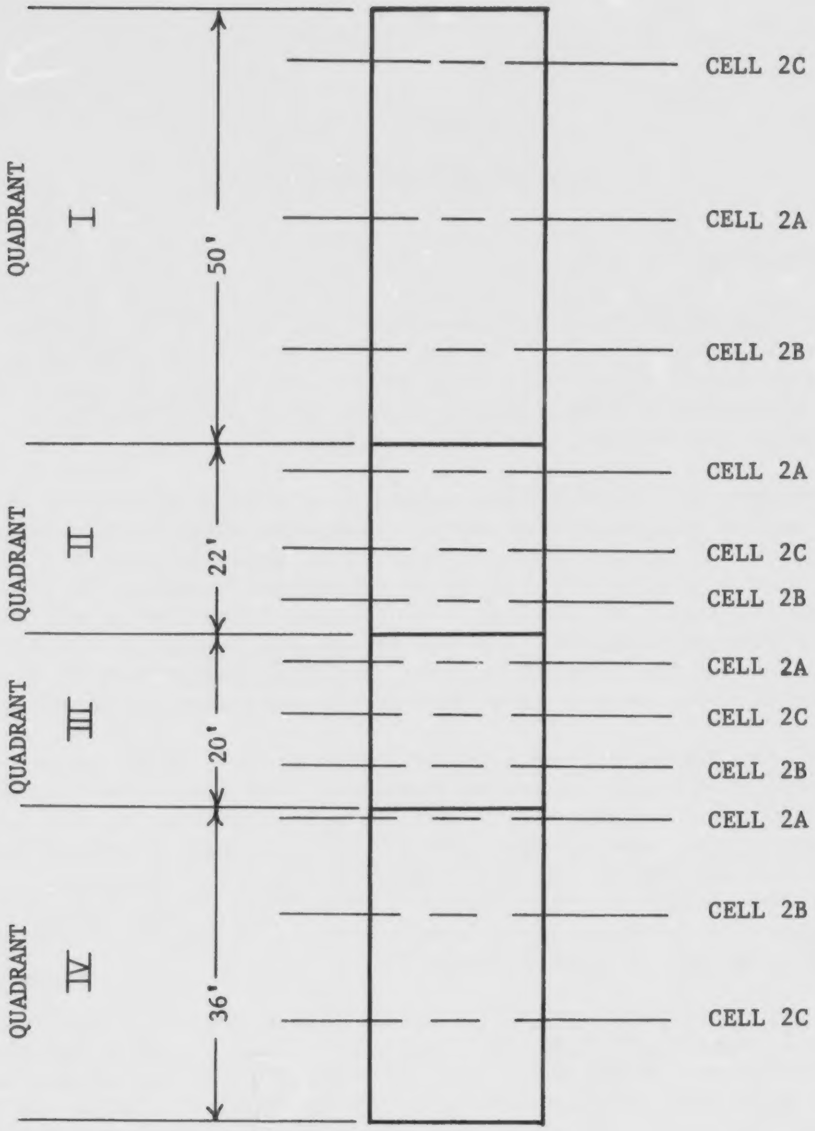
Residential solid waste from municipal and private collection routes was obtained for the test cell.(1) A total of 23 truckloads weighing 149.9 t was placed in a stockpile. Approximately 10% of the refuse in each truck was removed from the ordered stockpile and deposited at a position in a windrow in accordance with the arrival time of the refuse.

This windrow was divided into quarters on a weight basis as shown in Figure 7. Random assignments of sample locations within each quarter were made and twelve 136 kg samples were removed at that location for compositional analysis. Then approximately 726 kg of refuse was removed from each of the quadrants at the locations designated in Figure 7 for use in the cells. The pipes were filled sequentially and the refuse was always in the order quadrant 1, 2, 3, 4. Refuse was removed by hand, weighed, and placed in the pipes. Several samples were taken during filling for subsequent moisture analysis.

Refuse from the main stockpile was added to cell 2D by means of a clamshell so batch weights could not be recorded. The refuse was placed so that each of the four lifts in the cell came from the quadrant in the stockpile corresponding to the same windrow location. Estimates of refuse density were made while filling to try and achieve a similar refuse density to that obtained in the smaller cells. However, additional compaction of the lower lifts of refuse occurred as upper layers were being compacted and the final density was in excess of that desired.

Composition analysis was performed by hand sorting the twelve original samples. The results are presented in Tables 3 and 4. That fraction showing as fines represents the material passing through a 25.4 mm square mesh sieve not readily separated into any of the other categories. Using the method of Stell and Torrie (2) for unpaired observations and unequal variances the significance of the variations in refuse component means for cells 2A, 2B and 2C was determined. Results are presented in Table 5. None of the variations were significant at the 10% level. Therefore, any variations in the performance of cells 2A, 2B and 2C cannot readily be attributed to differences in the quantities of refuse within each category. The possibility of performance differences due to variations between the actual composition within each category was not examined.

Twenty samples of approximately 4.5 kg of the separated components were



1' = 0.3 m

Figure 7. Locations in windrow where refuse was obtained for cells 2A, 2B, and 2C.

TABLE 3. COMPOSITION OF RANDOM REFUSE SAMPLES

Windrow Sample Location		Total Weight Separated (lbs.)	Component-Percent by Wet Weight									
Quad.	Cell		Food Waste	Garden Waste	Paper	Plastics, Rubber, Leather and Textiles	Wood	Metals	Glass	Ash, Rocks and Dirt	Diapers	Fines
I	2A	288	4.48	8.21	52.7	7.62	0.45	7.13	6.23	1.36	0.66	11.17
I	2B	282	4.26	10.05	39.0	13.6	2.38	15.62	8.81	3.41	0.53	2.34
I	2C	260	4.96	7.42	46.8	5.08	11.58	9.54	6.00	0	0.038	8.58
II	2A	282	3.43	1.20	38.75	11.78	20.9	13.6	6.51	0.78	0.39	2.62
II	2B	296	2.19	28.6	44.7	6.75	0.47	7.79	7.89	0	0.067	1.55
II	2C	284	1.83	1.62	53.4	11.15	1.58	10.34	11.53	3.41	0.457	4.65
III	2A	289	1.52	9.34	58.6	13.3	0.415	4.92	6.16	0	1.87	3.81
III	2B	286	3.49	12.55	49.2	11.81	0.94	8.28	6.54	0	0.07	7.06
III	2C	282	3.68	21.65	40.8	14.0	7.25	7.01	2.44	0	0.46	2.62
IV	2A	288	2.33	2.05	65.8	9.96	1.63	6.74	5.10	0	0.90	5.52
IV	2B	287	10.18	4.47	46.9	7.77	0.42	10.50	11.89	0.63	5.55	1.71
IV	2C	299	12.11	2.74	53.8	11.10	1.20	9.07	6.26	0	0.234	3.42

TABLE 4. REFUSE COMPOSITION FOR CELLS 2A, 2B, 2C, and 2D

Cell	Statistic	Refuse Component - Percent by Wet Weight									
		Food Waste	Garden Waste	Paper	Plastics, Rubber, Leather and Textiles	Wood	Metal	Glass	Ash, Rocks and Dirt	Diapers	Fines
2A	Mean	2.94	5.20	53.96	10.66	5.85	8.10	6.00	0.535	0.955	5.78
	Stand.Dev.	1.29	4.17	11.5	2.45	10.0	3.79	0.62	0.66	0.64	3.79
2B	Mean	5.03	13.92	44.95	9.98	1.05	10.55	8.78	1.01	1.56	3.17
	Stand.Dev.	3.54	10.36	4.37	3.25	0.92	3.58	2.27	1.63	2.67	2.62
2C	Mean	5.65	8.36	48.7	10.33	5.40	8.99	6.56	0.85	0.30	4.82
	Stand.Dev.	4.50	9.21	6.17	3.75	4.96	1.42	3.75	1.71	0.20	2.64
2D*	Mean	4.54	9.16	49.20	10.33	4.10	9.21	7.11	0.799	0.936	4.59
	Stand.Dev.	3.29	8.44	8.16	2.91	6.29	3.01	2.63	1.29	1.54	2.99

* Determined from all observations for 2A, 2B, and 2C

TABLE 5. COMPARISON OF SAMPLE MEANS FOR CELLS 2A, 2B, and 2C

Refuse Component	Cell Comparison	t'*
Food Waste	2A-2B	1.110
	2A-2C	1.158
	2B-2C	0.217
Garden Waste	2A-2B	1.563
	2A-2C	0.625
	2B-2C	0.802
Paper	2A-2B	1.465
	2A-2C	0.806
	2B-2C	1.019
Plastics, Rubber, Leather and Textiles	2A-2B	0.334
	2A-2C	0.147
	2C-2B	0.141
Wood	2A-2B	0.951
	2A-2B	0.080
	2B-2C	1.724
Metals	2A-2B	0.941
	2A-2C	0.441
	2B-2C	0.810
Diapers	2A-2B	0.440
	2A-2C	1.941
	2B-2C	0.941
Fines	2A-2B	1.134
	2A-2C	0.416
	2B-2C	0.887

$*t' = \bar{d}/S_{\bar{d}}$; $S_{\bar{d}} = [S_1{}^2/N_1 + S_2{}^2/N_2]^{1/2}$

$t_{.1} = 2.353$ for df = 3

taken for moisture analysis. Samples were dried to a constant weight at 100-105°C for 24 hours. The samples had been stored for approximately 3 weeks in sealed plastic bags to prevent moisture changes, therefore transfer of moisture from one category to another was not prevented. The results are presented in Table 6.

A number of grab samples were also obtained during refuse placement for moisture determination. The results are presented in Table 7. The mean moisture content of the windrow samples was 24.1% with a standard deviation of 8.7%. The mean moisture content of the stockpiled samples was 31.9% with a standard deviation of 12.9%. A statistical comparison of sample means (2) revealed no significant differences in moisture at the 5% level. Therefore, any variations in the performance of cell 2D as compared to 2A, 2B and 2C cannot readily be attributed to differences in initial moisture content.

The amount of refuse, wet weight, placed in cells 2A, 2B, and 2C was 2,639 kg, 2,898 kg, and 2,813 kg, respectively. The wet densities were 392, 431, and 418 kg/m^3. Refuse placed in cell 2D was calculated to be 106.2 t at an in-place wet density of 598 kg/m^3. Initial refuse moisture content, by wet weight, was 22.5% for 2A, 27.1% for 2B, 24.1% for 2C and 31.8% for 2D.

Samples obtained for chemical analysis of the refuse were frozen for future analysis. These samples were inadvertently destroyed during transfer of the EPA office of Solid Waste from Cincinnati to Washington D.C. in 1973.

LEACHATE QUANTITY

The experimental design called for the input of approximately 500 mm of precipitation each year into all of the cells. Average annual rainfall at the site is in excess of 900 mm so all of the cells were periodically covered, the cylinders with caps and 2D with nylon reinforced Hypalon. Covers were not placed on the cells by any schedule but whenever needed to gain as uniform an input as possible throughout the year. Evaporation and transpiration losses were further reduced by use of the .3 m gravel layer overlying the soil cover, preventing vegetative growth and shielding the water stored on top of the soil cover from direct sunlight.

Leachate Volume

Leachate was initially collected from each test cell on the date and at the cumulative rainfall quantities in Table 8.

TABLE 6. MOISTURE CONTENT OF SEPARATED REFUSE COMPONENTS

Windrow Sample Location	Refuse Component	Percent Moisture	Percent by Weight of Component in Total Sample
Quad III Cell 2B	Fines	17.2	7.1
	Food	42.2	3.5
	Wood	15.4	0.9
	Garden	53.7	12.5
	Paper	25.4	49.2
	Plastics, Rubber, Leather & Textiles	15.5	11.8
	Metal	10.9	8.3
	Glass	0.44	6.5
			Σ = 99.8
Quad I Cell 2A	Fines	27.1	11.2
	Food	40.6	4.5
	Garden	54.3	8.2
	Paper	36.3	52.7
	Plastics, Rubber, Leather & Textiles	22.7	7.6
	Metal	7.8	7.1
	Glass	2.0	6.2
			Σ = 97.5
Quad III Cell 2C	Food	49.3	3.7
	Garden	44.1	21.7
	Paper	32.6	40.8
	Plastics, Rubber, Leather & Textiles	29.3	14.0
	Metal	4.6	7.0
			Σ = 87.2

TABLE 7. MOISTURE CONTENT OF REFUSE SAMPLES FOR CELLS 2A, 2B, 2C AND 2D

Sample Location			Wet	Percent Moisture by Wet Weight				
Windrow		Stockpile	Sample	Date Sample Obtained				
Quad	Cell	Quad	Weight	8/14	8/15	8/16	8/17	8/18
I	2A		12.0	28.0				
I	2B		23.0	23.0				
I	2B		23.0	31.2				
I	2C		8.3	31.8				
I	2C		17.6		18.9			
III	2A		26.0	7.0				
III	2A		12.75	35.7				
III	2C		18.2		16.7			
IV	2A		18.0	19.4				
IV	2C		15.9		29.1			
		I	14.2			31.7		
		I	22.0		34.0			
		II	13.3			38.4		
		II	8.5			37.2		
		III	10.2				20.0	
		III	16.0				17.4	
		IV	21.0					56.3
		IV	11.0					20.0

TABLE 8. INITIAL COLLECTION OF LEACHATE

Test Cell	Date Leachate Collected	Cumulative Precipitation[a]
2A	6-5-73	724
2B	2-13-73	588
2C	6-19-73	765
2D	9-25-72	51

[a] millimeters

Figures 8 and 9 show the quantities of leachate collected from each test cell with time and with precipitation. Test cell 2C produced very little leachate during the reporting period in comparison to 2A and 2B. A test boring in the cell did not show any free water stored in the cylinder. It is assumed that a leak developed at a welded joint near the surface of the soil cover and very little of the precipitation actually entered the refuse mass. The leachate data from cell 2C will not be considered for the remainder of this section. The raw data is included in the appendices.

The quantities of leachate collected from 2A and 2B vary slightly, but by the end of 1976 50% more than 2A and 72% more than 2B per unit of surface area had been collected from 2D. One possible cause of this large difference could be leakage into cell 2D through the walls. There also could be leakage through the membrane cover. The quantity of leachate collected from 2D over the reporting period was in excess of the precipitation that occurred when the membrane cover was removed.

Evaporation

Table 9 shows the quantity of precipitation and leachate collected from each cell for each period during which the cells were uncovered and then covered. The time delay between precipitation and leachate collection is not as long as it appears to be from the table because the cells were frequently covered soon after heavy rains. Table 10 was prepared to determine the significance of evaporation losses, grouping the precipitation and leachate collection data as close as possible in seasonal sums after leachate flow became relatively consistent. The percent of the precipitation collected as leachate in the summer does not show any evidence of evaporation losses for 2A and 2B. It is not possible to tell whether the lower summer precentage for 2D is due to evaporation or whether there is more leakage into the cell during the winter when more water is available from the surrounding soil.

Absorptive Capacity of Refuse

The time delay between initial precipitation input and eventual steady leachate production results from the absorptive capacity of the refuse being achieved, or field capacity being reached. The field capacity for the refuse can be estimated from the work of Fungaroli and Steiner (3), knowing the in-place density of the refuse. These values are presented in the first column of Table 11.

The water required to bring the test cells to field capacity can be estimated using these values presented in the first column times the initial refuse depth, and then subtracting the initial moisture stored in the refuse and adding in 50 mm of water required to achieve field capacity in the cover soil (4). This value is listed in the second column of Table 11.

In order to compare this estimated value with the apparent water required, graphs for the test cells, such as Figure 10, were prepared, and the apparent water required was chosen as that precipitation less leachate value when leachate production initially became steady. This apparent

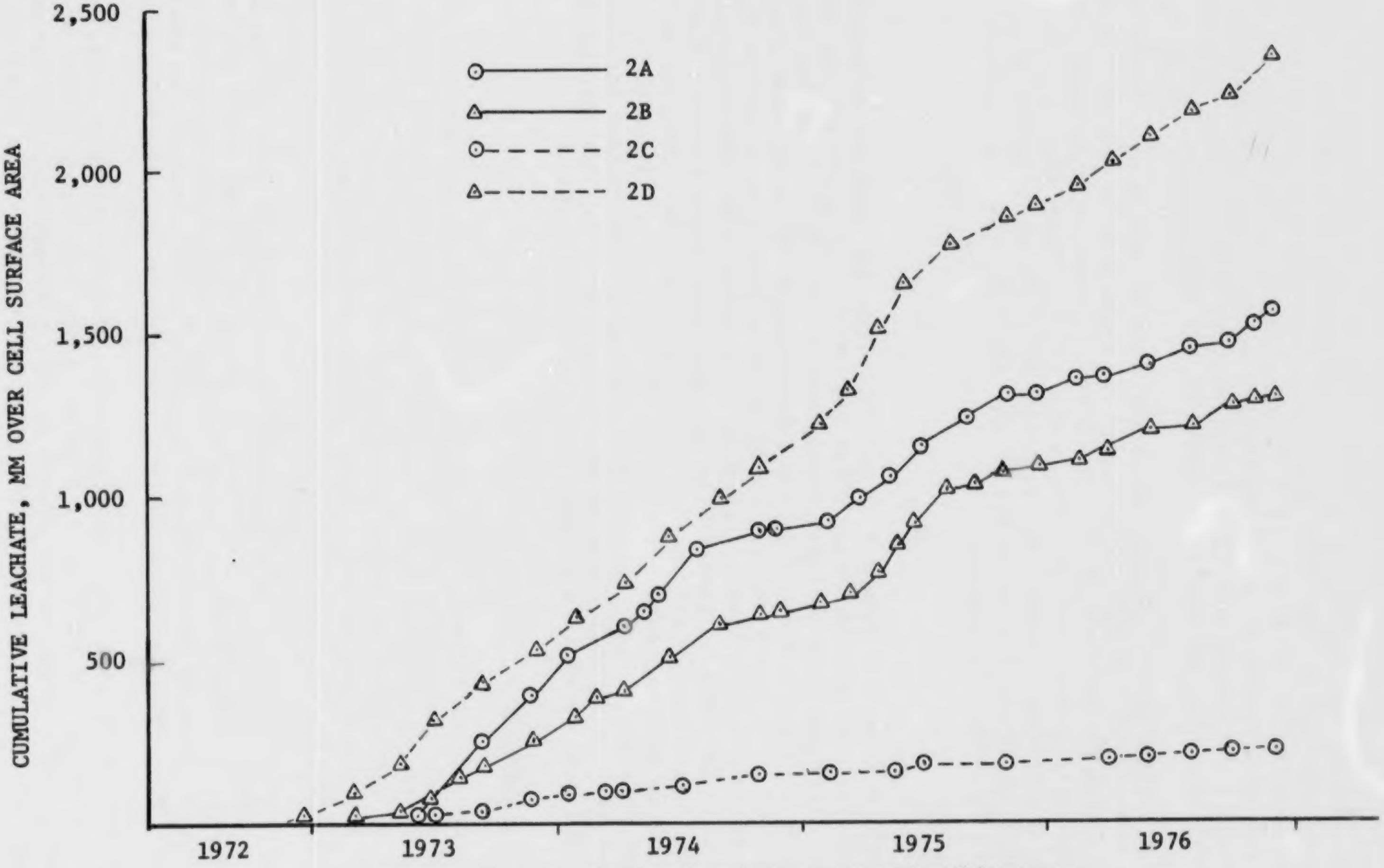


Figure 8. Cumulative leachate collection history.

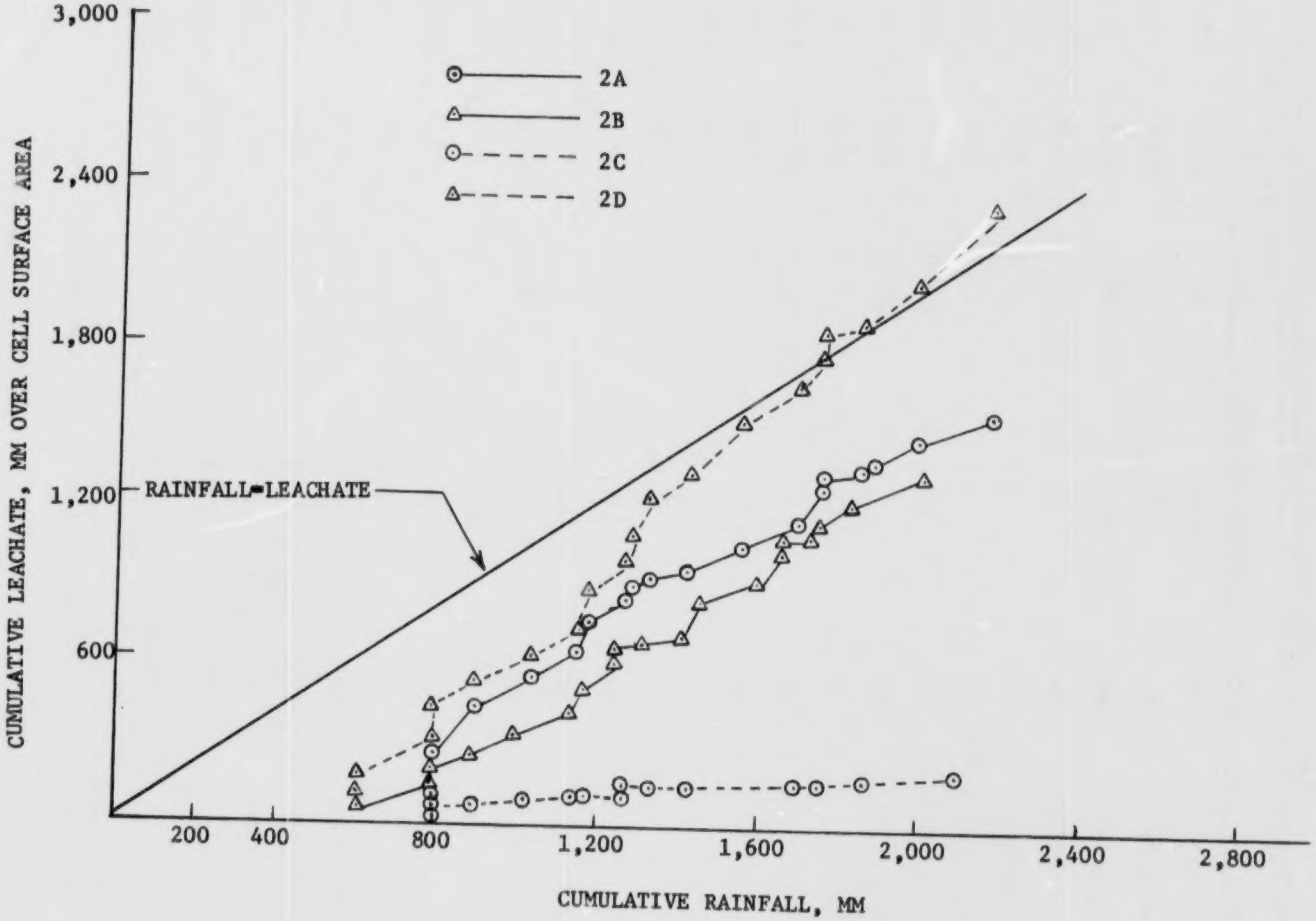


Figure 9. Cumulative leachate collected.

TABLE 9. PRECIPITATION AND LEACHATE QUANTITIES

			Leachate Quantity[b]		
Dates	Cover	Precipitation[a]	2A	2B	2D
8/72-3/1/73	Off	609.3	0	12.0	96.3
3/1/73-5/8/73	On	0	0	23.4	85.3
5/8/73-6/26/73	Off	186.9	50.4	40.3	67.8
6/26/73-9/19/73	On	0	201.8	103.7	183.4
9/19/73-10/2/73	Off	75.7	36.0	8.6	28.1
10/2/73-11/27/73	On	0	116.6	52.5	51.2
11/27/73-1/18/74	Off	143.3	105.0	54.7	74.6
1/18/74-3/15/74	On	0	100.1	74.5	96.0
3/15/74-4/8/74	Off	120.0	16.3	10.5	46.8
4/18/74-6/3/74	On	0	105.7	100.8	136.4
6/3/74-7/1/74	Off	112.0	17.2	21.4	44.8
7/1/74-10/31/74	On	0	138.4	133.6	175.9
10/31/74-11/29/74	Off	72.1	9.9	12.0	24.7
11/29/74-2/20/75	On	0	24.4	32.3	200.7
2/20/75-3/24/75	Off	145.5	21.1	20.3	74.8
3/24/75-5/20/75	On	0	133.2	149.9	182.2
5/20/75-6/19/75	Off	199.5	54.9	65.1	85.8
6/19/75-11/6/75	On	0	180.0	151.8	199.6
11/6/75-12/15/75	Off	64.8	9.2	8.9	28.2
12/15/75-4/6/76	On	0	46.8	53.7	149.2
4/6/76-6/3/76	Off	98.8	15.2	19.9	62.4
6/3/76-8/17/76	On	0	65.9	61.1	95.8
8/17/76-1/4/77	Off	221.7	108.3[c]	149.5[d]	156.8[d]
	Totals	2049.6	1556.4	1360.5	2346.8

a. millimeters
b. millimeters - volume per unit of collection surface area
c. through 12/7/76
d. through 1/4/77

TABLE 10. SEASONAL PRECIPITATION AND LEACHATE

Dates	Precipitation[a]	Leachate[b] 2A	2B	2D
5/8/73-11/27/73	262.6	404.7	205.2	330.6
11/27/73-3/15/74	143.3	205.1	129.2	195.5
3/15/74-10/31/74	232.0	277.5	266.3	378.8
10/31/74-5/20/75	217.6	188.6	214.8	482.4
5/20/75-11/6/75	199.5	234.9	216.8	285.4
11/6/75-4/6/76	64.8	56.0	62.6	177.4
4/6/76-8/17/76	98.8	81.1	81.0	158.2
Summer Totals	792.9	998.2	769.3	1153.0
	% of Precipitation	125.9%	97.0%	145.4%
Winter Totals	425.7	449.7	406.4	855.3
	% of Precipitation	105.6%	95.5%	200.9%

a. millimeters

b. millimeters = volume per unit of collection surface area water requirement is in the third column of Table 11. The apparent field capacity is presented in the fourth column.

TABLE 11. REFUSE FIELD CAPACITY

Test Cell	Estimated Refuse Field Capacity [a]	Estimated Water Required to Reach Field Capacity[b]	Apparent Water Required to Reach Field Capacity[b]	Apparent Refuse Field Capacity[c]
2A	350	706	720	356
2B	358	669	590	327
2D	400	560	500	375

a. millimeters/meter of refuse depth, after Fungaroli and Steiner (3)

b. millimeters

c. millimeters/meter of refuse depth

The values of estimated and apparent field capacity compare favorably, being within 10% or less of each other for all cells. Values might be closer, but the sequence of covering and uncovering the cells makes leachate flow erratic and the graphical estimating of when leachate flow becomes steady difficult.

LEACHATE COMPOSITION

Leachate samples were obtained on a bi-weekly schedule for the reporting period. The samples were analyzed at a commercial laboratory in Cincinnati for a number of parameters with the most extensive testing being performed on a monthly and quarterly samples. The complete analytical results for all cells are included in the appendices. The results from test cell 2C have not been examined because of the previously mentioned problems of low water flow through the test cell.

The large amount of data from sample testing required reduction to fewer data points for analysis of the concentration histories. Work from test cell 1 indicated that concentration histories were more total water flow than time dependent so the sample concentration data were reduced to weighted mean concentrations at the approximate time at which 100 mm intervals of leachate flow were recorded. This normalized the data for each cell so that concentration histories were based on a parameter accounting for the varying leachate quantities collected from each cell.

Weighted mean concentrations were calculated by computing the mass of

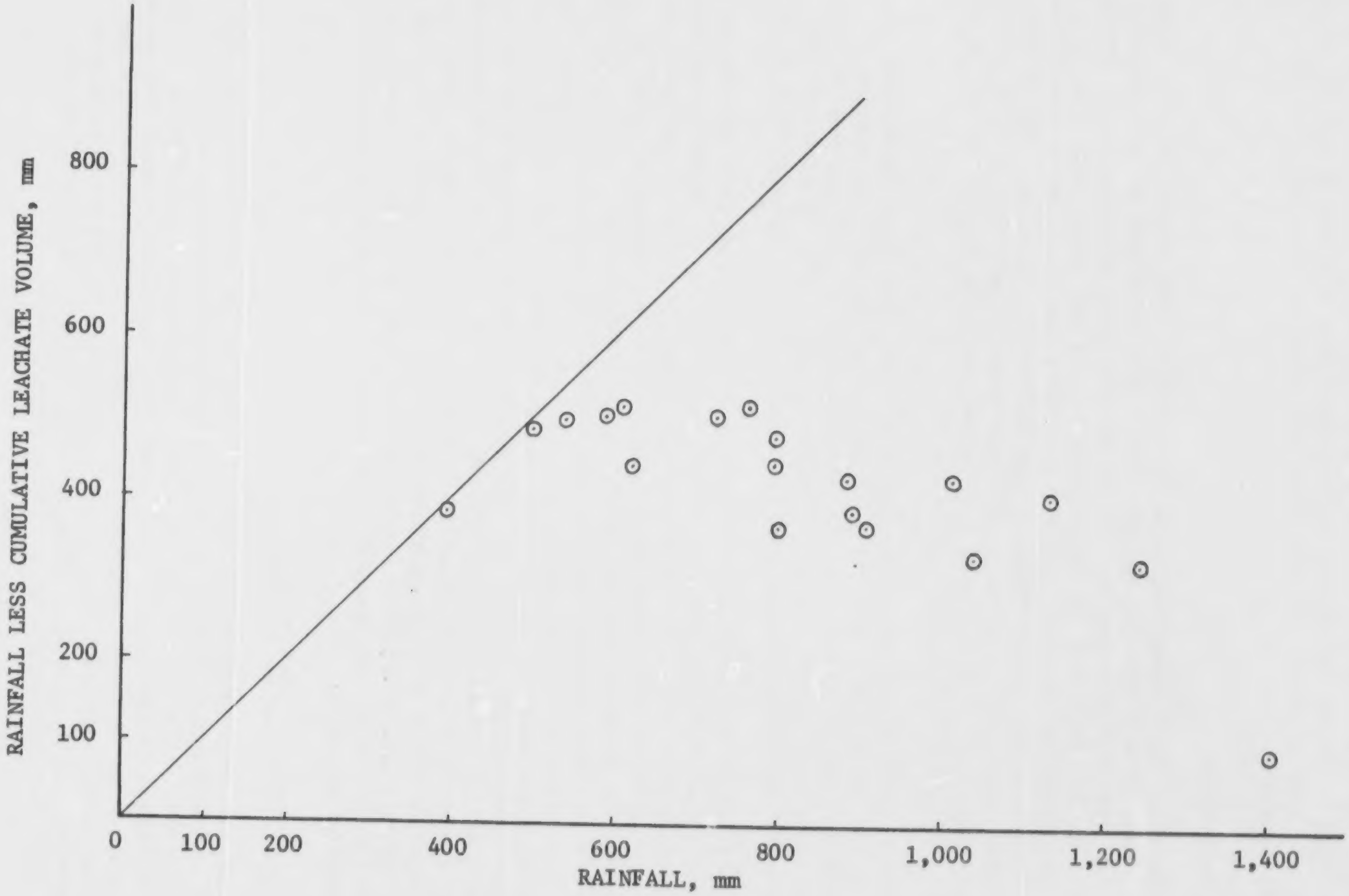


Figure 10. Field capacity determination, cell 2D.

the parameter collected, from sample to sample, based on the volume of leachate collected between samples, multiplied by the most recent sample concentration. The sum of these masses for each sample date divided by the total quantity of flow (approximately 100 mm) gave the weighted mean concentration for the 100 mm interval.

Peak Concentrations

A summary of peak concentrations, the date of the sample and the leachate volume per unit of surface area at which the peak occurred is presented in Table 12 for selected parameters. It is notable that all but one of the peak concentrations for test cell 2A occurred within a two month time span starting with the onset of leachate production. This was the time period during which or shortly after field capacity was achieved. This same result was noted in test cell 1 (5). Apparently these peak concentrations were the result of initial water contact with the refuse when the supply of the leachable substances and the contact time was high.

For test cell 2B the time span for peaks was somewhat longer than 2A, ranging to over 6 months. Test cell 2B did begin leachate production 4 months earlier than 2A and before the estimated field capacity was reached so this range might actually have coincided closely with 2A with the peak concentrations occurring during or shortly after field capacity was reached.

For test cell 2D the general time span for peaks was four months, with calcium and total hardness somewhat later. The volume of leachate collected prior to and during this time range was much greater though than for 2A and 2B and somewhat later than when sufficient precipitation had entered to satisfy both the apparent and estimated water requirements. It did not appear that the peak concentrations for 2D occurred during the period that field capacity was reached as occurred for 2A, 2B and test cell 1. If peaks did occur during this period then the high concentrations in the leachate would had to have been either reduced by significant diluting leakage from the sides of the cell or by channelling through the cell. The latter situation would result in field capacity not actually having been achieved until somewhat after estimated water requirements had been met, possibly during the time and leachate volume range when peak concentrations were recorded. Dilution was indicated by the lower magnitude of almost all of the peak concentrations of 2D as compared to 2A and 2B.

Leachate Composition Comparibility

One of the primary objectives of the test cells was to evaluate the behavior of a field-scale test cell, 2D, compared to similarly constructed small-scale test cells 2A, 2B and 2C. The concept was to determine whether similarity existed between individual small-scale cells for such things as well as similarity between the small-scale cells and the field-scale cell, 2D. It was hoped that the small-scale cells would be adequate models of the large-scale cell so that future research efforts might utilize the smaller cells for prediction of field behavior.

TABLE 12. PEAK CONCENTRATIONS

	Test Cell 2A			Test Cell 2B			Test Cell 2D		
Parameter	Concen-tration[a]	Date	Leachate[b]	Concen-tration[a]	Date	Leachate[b]	Concen-tration[a]	Date	Leachate[b]
Initial Leachate	-	6-5-73	-	-	2-13-73	-	-	9-25-72	-
COD	57330	7-31-73	133	61600[c]	4-24-73	32	41869	11-7-73	500
Total Kjeldahl-N	1560	7-31-73	133	1897	10-23-73	217	1242	10-23-73	486
Ammonia-N	1035	11-7-73	389	1185	10-23-73	217	947	11-20-73	512
Ortho-phosphate	390	6-5-73	17	185	6-19-73	76	82	7-31-73	383
Sulfate	1306	7-31-73	133	2000	10-23-73	217	1280	11-7-73	500
Sodium	1900	8-14-73	173	1700	7-17-73	139	1375	8-28-73	417
Potassium	2225	7-17-73	115	2939	11-7-73	230	1893	11-7-73	500
Chloride	2335	7-31-73	133	2343	9-25-73	188	2260	10-9-73	473
Iron	1547	8-14-73	173	2902	4-24-73	32	1183	9-25-73	447
Magnesium	486	7-31-73	133	617	10-23-73	217	411	11-20-73	512
Manganese	109	6-5-73	17	115	5-8-73	35	58	8-14-73	401
Calcium	2280	7-17-73	115	4000	5-8-73	35	2300	1-29-74	628
Zinc	150	7-17-73	115	360	7-17-73	139	67	7-3-73	318
Hardness	7067	6-19-73	50	10575	4-24-73	32	6713	12-16-75	1883
Total Solids	46484	7-31-73	133	45628	7-31-73	149	36252	8-14-73	401
pH	6.2	7-31-73	133	6.0	12-4-73	251	6.2	10-2-72	2
Alkalinity	11535	7-31-73	133	13880	2-27-73	12	8963	2-26-74	667
Acidity	6720	6-19-73	50	6843	7-17-73	139	5057	2-26-74	667
Conductivity	17000	8-14-73	173	18000	8-14-73	161	16000	8-13-74	985

[a] mg/l

[b] millimeters - cumulative leachate volume per unit of collection surface area

[c] early peak, concentration later dropped and peaked again on 11-7-73 sample

Several inputs which are thought to be the major factors in leachate concentrations and volumes are the initial refuse composition, the depth of refuse, the in-place density and the quantity of water entering the cell. The experimental design was to keep these factors constant for all cells.

It was determined that on the basis of a 10 component analysis of composition that variations in performance between cells 2A, 2B and 2C could not readily be attributed to variation in refuse composition. Unit wet weights of 2A, 2B and 2C were similar, ranging from 392-431 kg/m^3. The refuse depth was the same for all small cells. Water input to each cell was assumed to be the same but the leachate production varies somewhat between 2A and 2B and very widely for 2C, as shown previously in Figures 8 and 9.

The initial refuse composition for cell 2D was assumed similar to that of the small cells. The density was somewhat greater at 598 kg/m^3 at a slightly higher moisture content. The possible effect on leachate concentration of this greater density is not known. The input of water was assumed to be the same as to the small-scale cells but it was obvious from Figure 9 that it was not since cumulative leachate production was presently greater than the precipitation. Refuse depth was slightly less in 2D at 2.44 m whereas in the small cells the depth was 2.56 m.

The concentration history and mass removal curves for selected parameters are presented in Figures 11-39. To determine whether the concentration histories were similar for 2A and 2B an analysis of differences was performed according to the method described by Natrella (6). The differences were compared at the 10% significance level. If there was no significant difference between 2A and 2B the same analysis was performed comparing the average concentration of 2A and 2B to that of 2D. If there was a significant difference between 2A and 2B, then the concentrations of each cell, rather than an average, were compared to 2D. This same paired difference test was used to compare the mass removal of selected parameters for 2A and 2B. Two tests were performed on each set of data, one compared the cumulative mass removal curves, the other the increases in mass removed over each 100 mm interval.

pH

The pH on the sample date at the 100 mm intervals, Figure 11, was reasonably close for cells 2A, 2B and 2D. There was a low period for each plot which coincides generally with the achievement of field capacity. Afterwards the pH for the 3 cells remained in the 4.8-5.4 range. Only cell 2D showed any tendency of rising, indicating lower volatile acid production. There was some dependence of higher pH to high leachate production, indicating some dilution of the buffering system. These rises were of short duration due to the covering of the test cell, usually following heavy precipitation input. Generally the pH of test cell 2D was higher than 2A and 2B as was the leachate production.

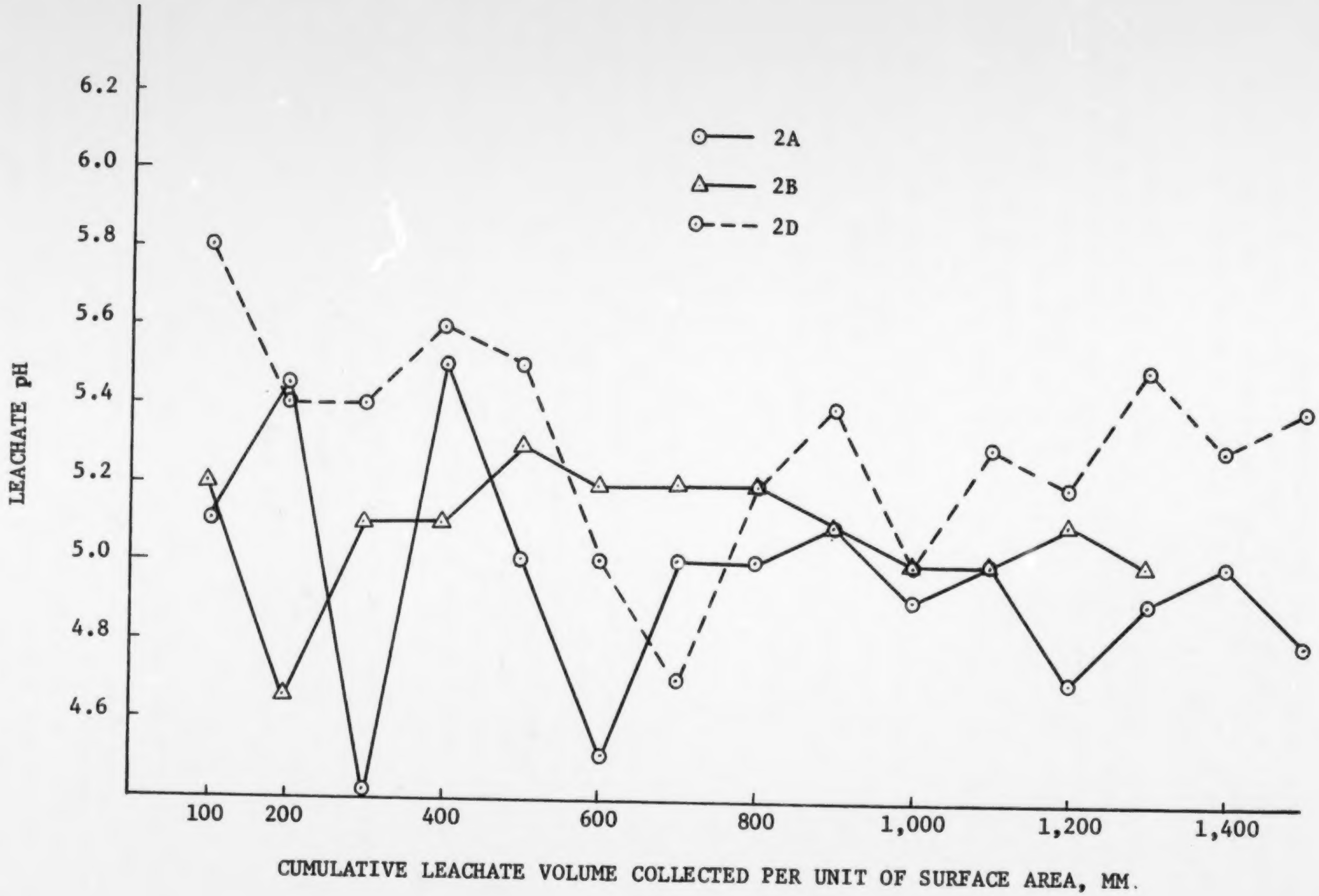


Figure 11. Leachate pH.

COD- BOD

The COD was determined on all bi-weekly samples for all 4 test cells. BOD analyses were run periodically but results were variable and not considered reliable. The weighted mean concentration of COD with leachate volume is shown in Figure 12 and the cumulative mass removal per unit weight of dry refuse in Figure 13.

Concentration history curves for 2A and 2B coincide reasonably well but because the level of 2B is generally higher than that of 2A the paired difference test indicated the average difference was significant at the 10% confidence level. Neither 2A or 2B was statistically similar to 2D. The concentration in 2D lagged that of 2A and 2B until after its peak concentration was reached, then agreement was reasonably close. A paired difference test of 2A versus 2D beginning at the 500 mm data point showed no significant difference.

Cumulative mass removal per unit weight of dry refuse for cells 2A and 2B was very close, even with the varied leachate production over the time elapsed. Removal of COD from 2D has been much slower than from the small-scale cells; the difference tended to increase with time and cumulative leachate volume. This trend could be due to channelling or leakage from the sides through 2D, lowering the removal rate.

Sulfate

Sulfate analyses were done on all bi-weekly samples for all test cells. Weighted mean concentration histories for 2A and 2B, Figure 14, showed peaks at the same cumulative volume of flow. Paired difference test results showed a significant difference at the 10% level between the history curves of 2A and 2B. Both 2A and 2B showed no significant difference when compared to the weighted mean concentration of 2D, even though the 2D plot did not visibly coincide with either small-scale cell history during most of the test period. The lower concentrations at the beginning and the higher concentrations at the end produced a low average difference over the entire history and a large standard deviation, resulting in no significant difference.

The cumulative mass removals, Figure 15, for 2A and 2B showed no significant difference for 100 mm interval increases in mass removed. 2D mass removal per unit weight of dry refuse was far below that of 2A and 2B as was the case for COD, but the rate of removal from 2D after 500 mm was similar to that of 2A and 2B whereas for COD the rate was lower.

Nitrogen

Analyses were performed for Kjeldahl and ammonia nitrogen on all samples and occasionally for nitrate and nitrite. Similar Kjeldahl and ammonia nitrogen weighted mean concentration histories, Figures 16 and 18, for the 3 cells as compared to COD and sulfate were noted, with similarly timed peaks for 2A and 2B, a delayed peak for 2D, and higher concentrations for 2D after 600 mm. Paired difference testing showed a significant difference between 2A and 2B for Kjeldahl nitrogen and no significant difference for ammonia nitro-

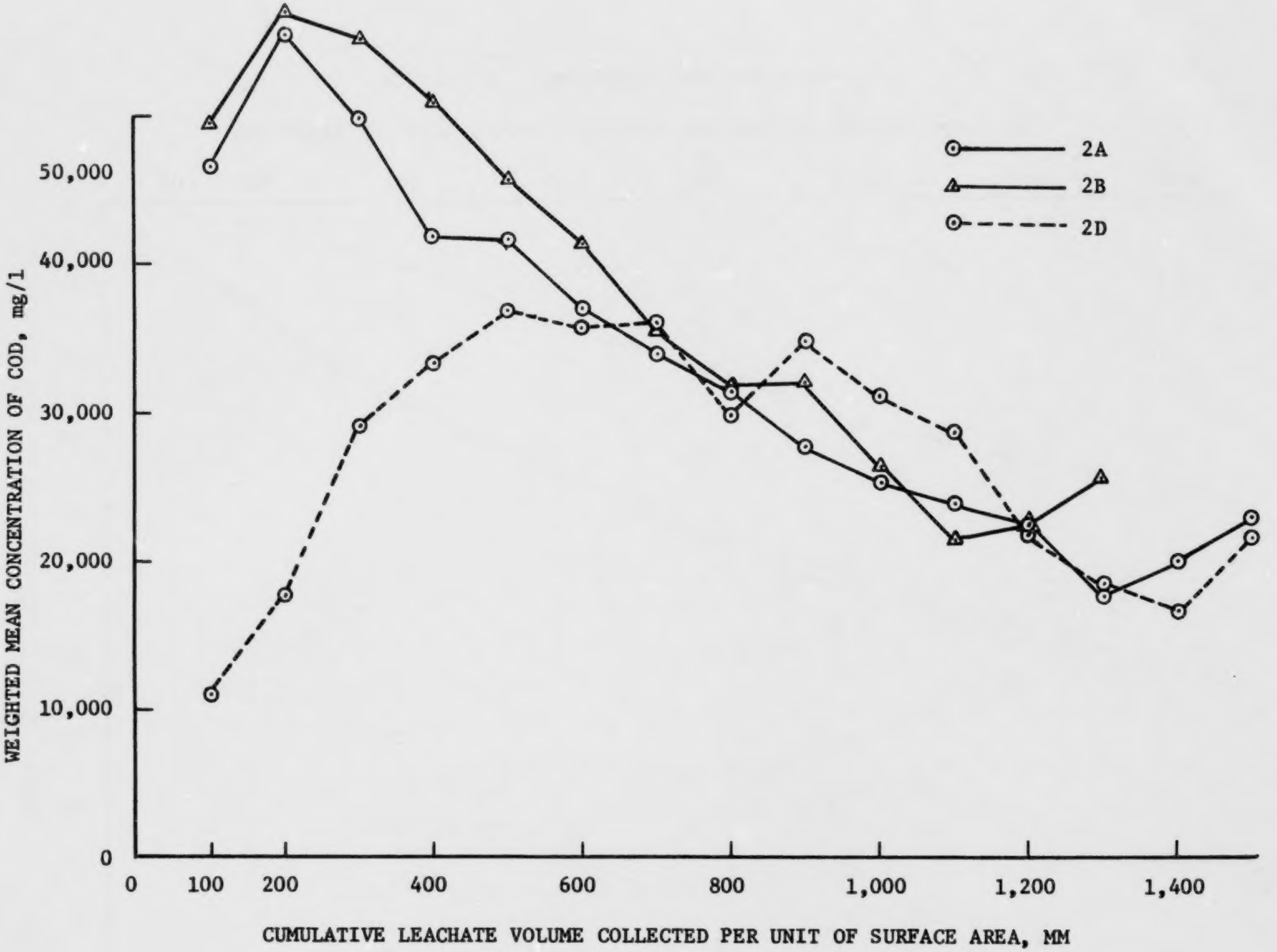


Figure 12. Weighted mean COD concentration.

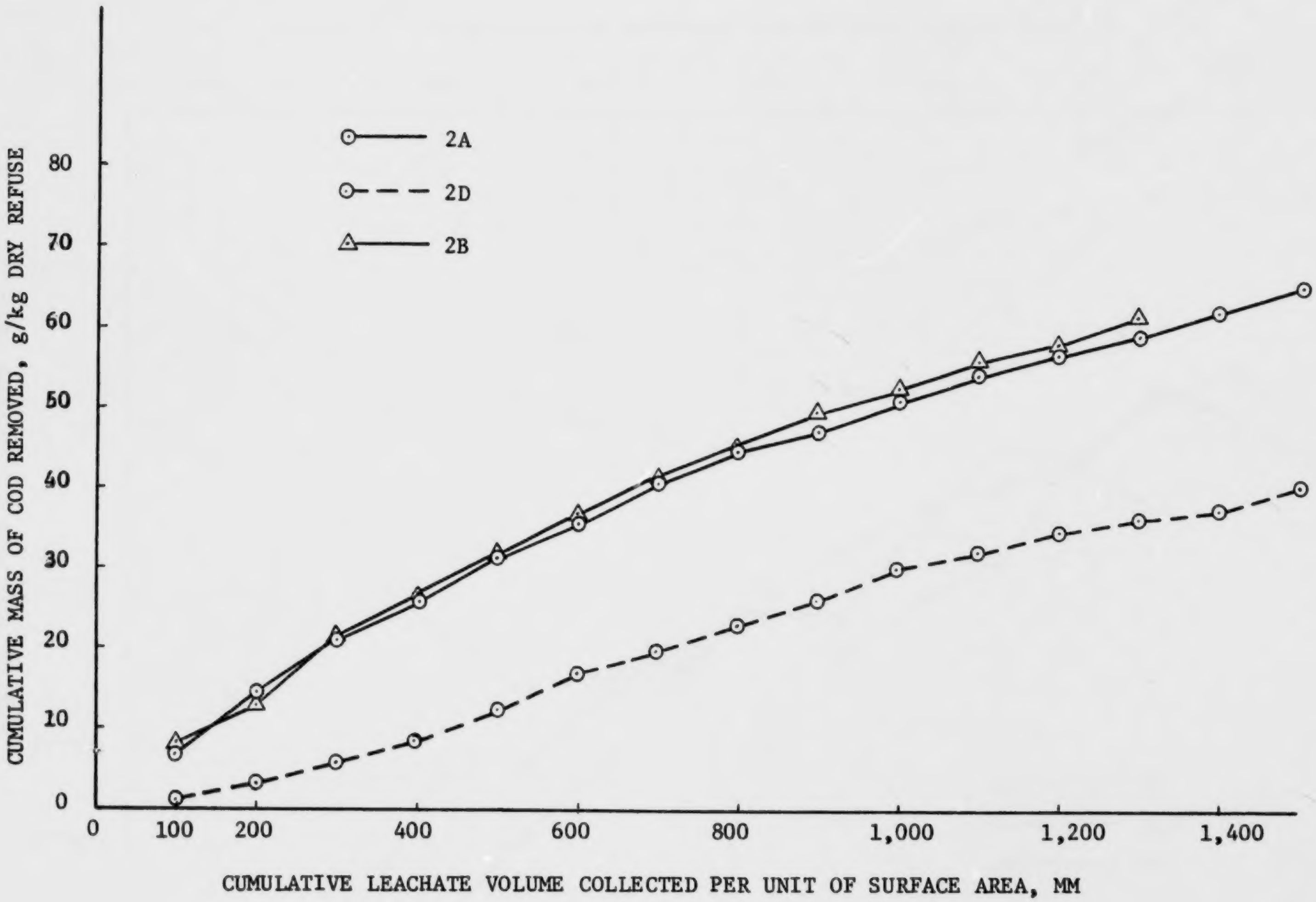


Figure 13. Cumulative COD mass removal.

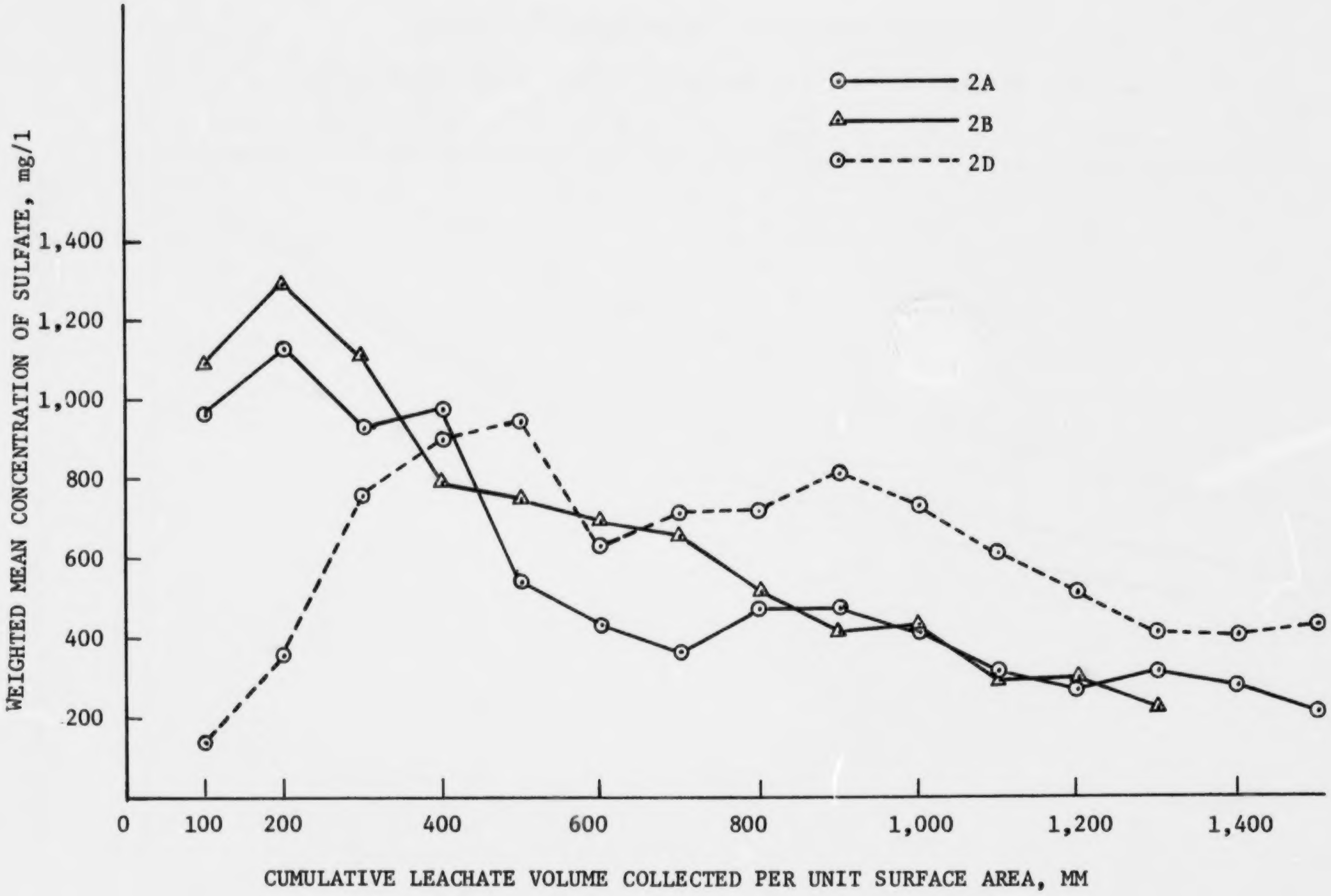


Figure 14. Weighted mean sulfate concentration.

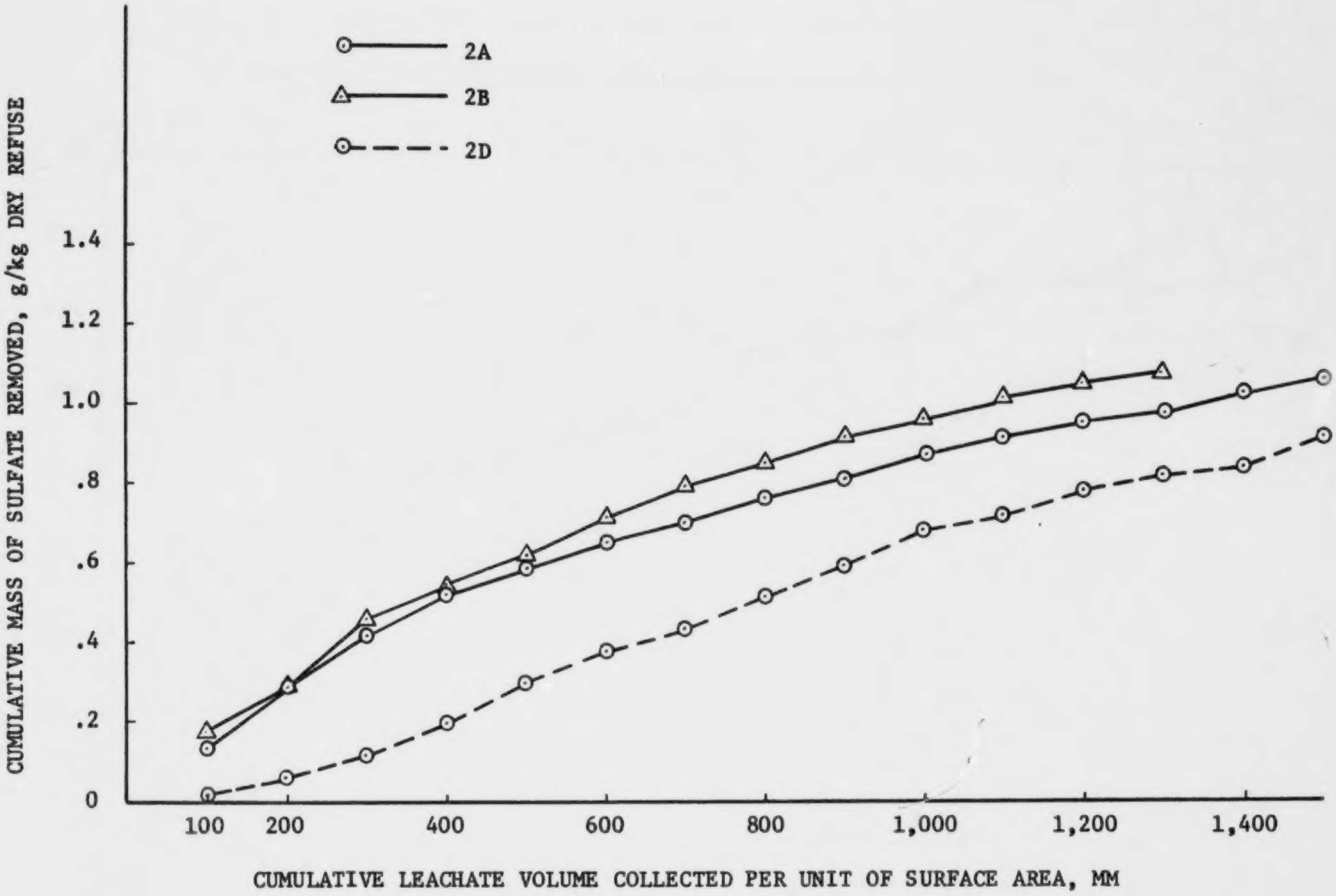


Figure 15. Cumulative sulfate mass removal.

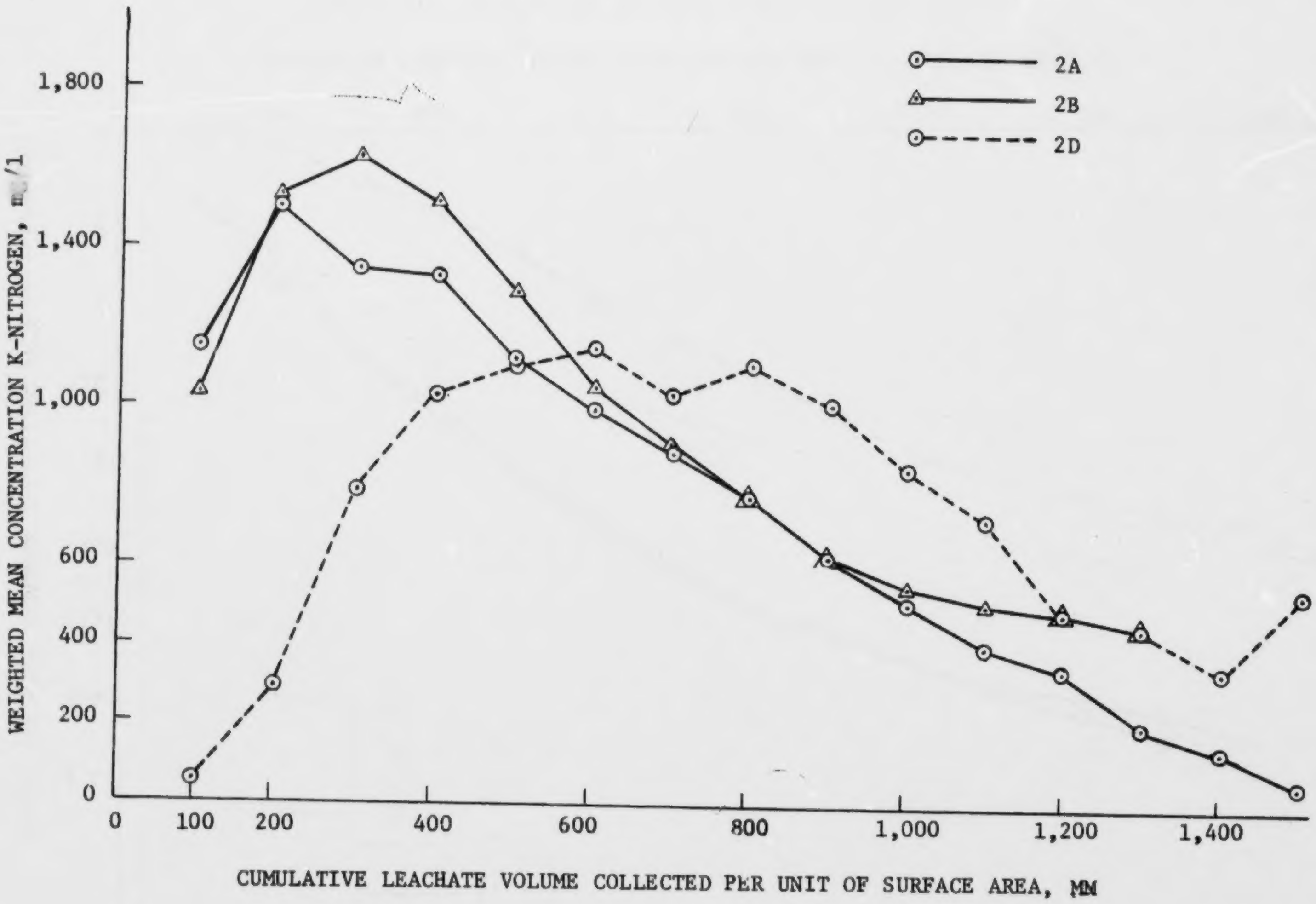


Figure 16. Weighted mean Kjeldahl nitrogen concentration.

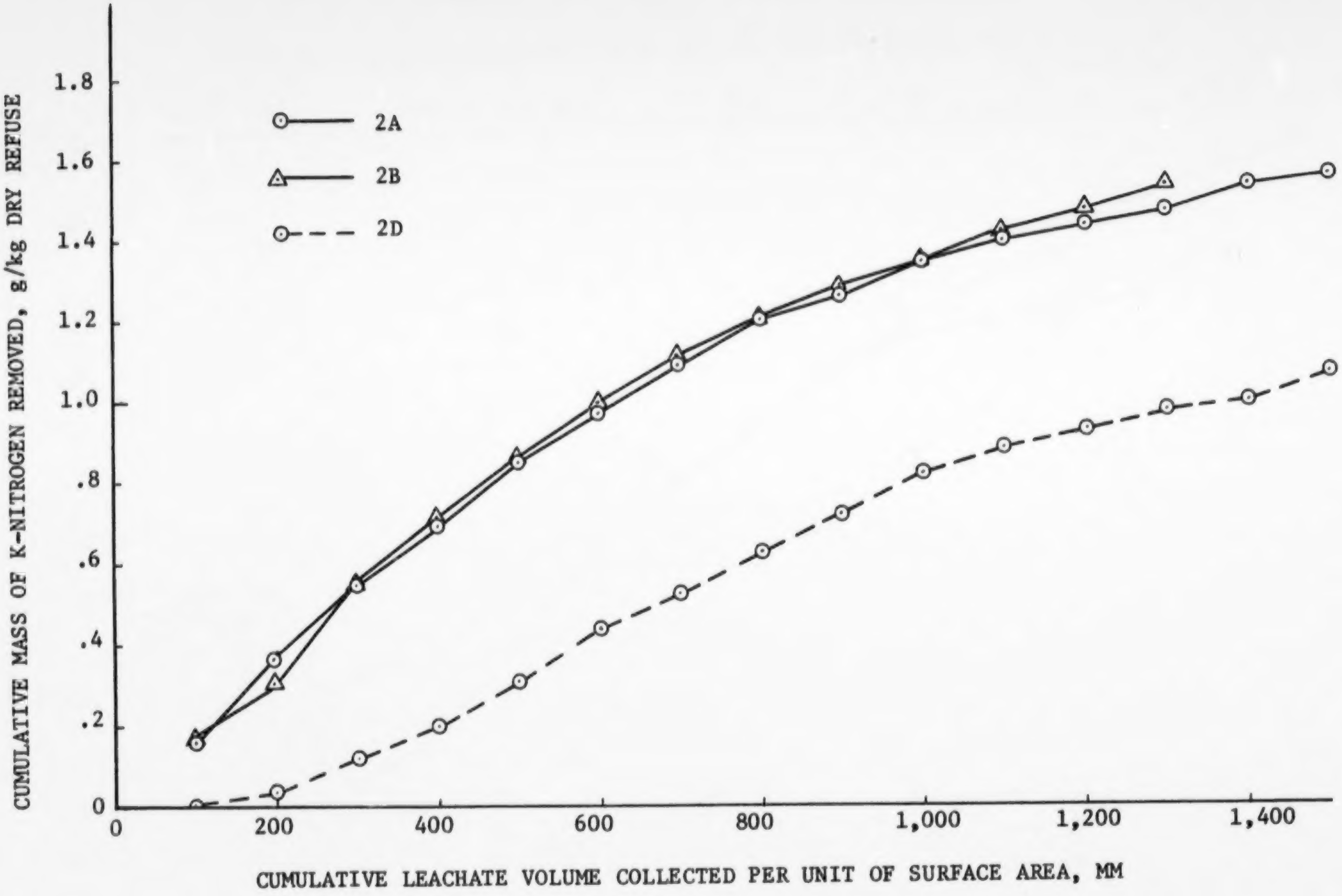


Figure 17. Cumulative Kjeldahl nitrogen mass removal.

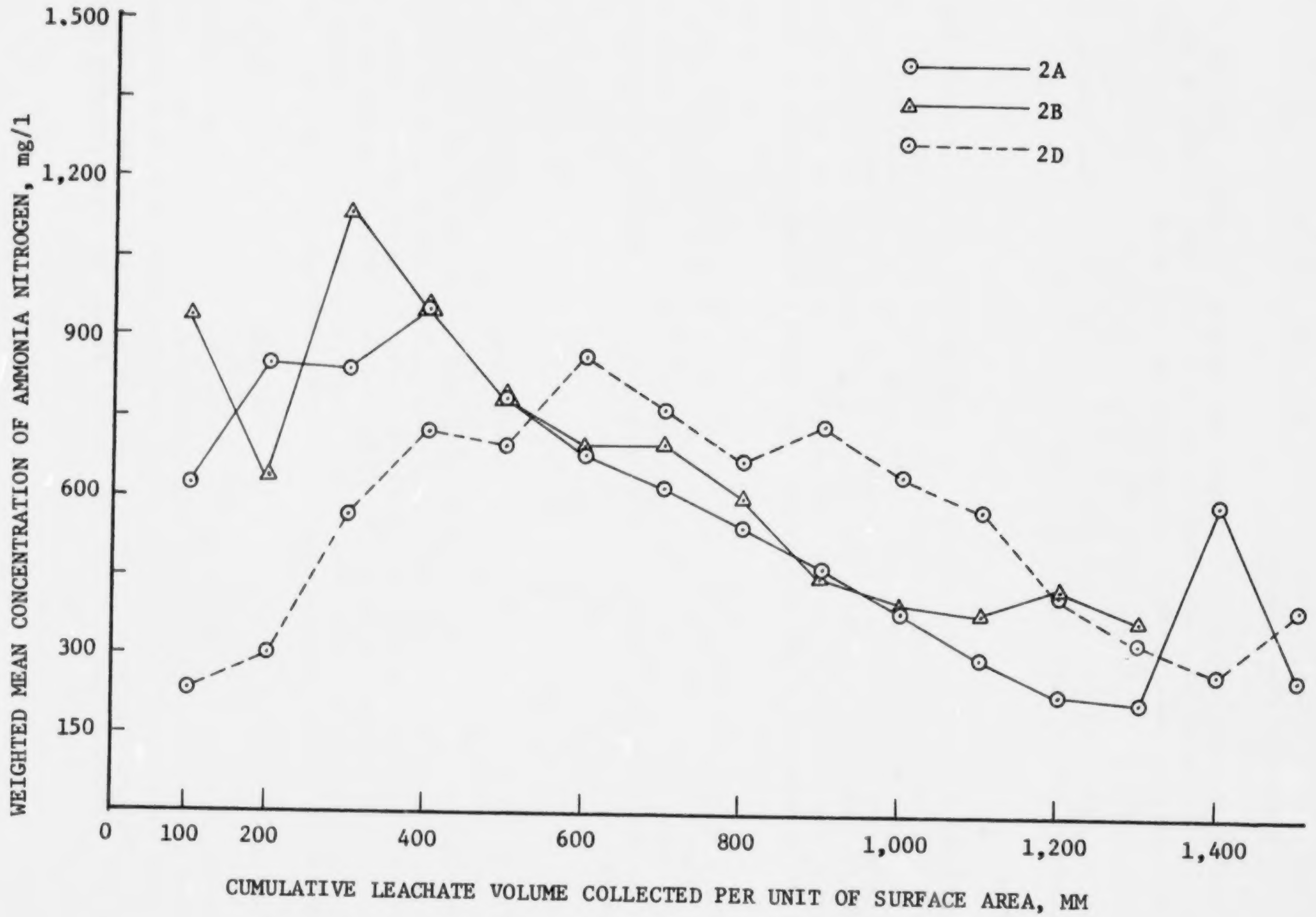


Figure 18. Weighted mean ammonia nitrogen concentration.

gen. The average of 2A and 2B for ammonia nitrogen was not significantly different from the weighted mean concentrations of 2D, again due to lower initial values and then larger later values which resulted in a low average difference and a large confidence interval.

Cumulative mass removals of ammonia and Kjeldahl nitrogen, Figures 17 and 19, for 2A and 2B were very similar and no significant difference was noted for interval mass removed. 2D removal per unit weight of dry refuse was lower as was found with COD and sulfate, seemingly due to the depressed mass removal which occurred prior to the peak concentration; afterwards, the curves paralleled the removal patterns of 2A and 2B. Total mass removed was approximately 40% as ammonia nitrogen and 60% as Kjeldahl.

Phosphate

Analyses were done for ortho and total phosphate, more frequently for the former. The weighted mean concentration history curves for the test cells and the cumulative mass removed are presented in Figures 20 and 21 for orthophosphate. A significant difference between 2A and 2B was obtained from the paired difference test on the weighted mean concentration histories, but no significant difference when 2A was compared to 2D and 2B to 2D. A significant difference was found in interval mass removal increases between 2A and 2B.

The peak concentration for 2D occurred some 300 mm earlier than for the other organic parameters, but it was still delayed beyond the peaks for 2A and 2B. After 500 mm the weighted mean concentrations of all 3 cells remained in the 10-50 mg/1 range, with no apparent large decrease with time or flow volume.

Chloride

Figures 22 and 23 show the weighted mean concentration histories and cumulative mass removals of chloride for the test cells. Peak concentrations were recorded early for chloride in both 2A and 2B, indicative of high solubility and availability. The peak for 2D was again delayed until 500 mm. Thereafter the concentrations tended to range quite widely but all three followed a general trend downward to concentration levels of 300-600 mg/1. The slopes of the mass removal curves were decreasing at 1500 mm, indicating the approach of either complete removal or limited available chloride.

Average difference tests showed no significant difference between 2A and 2B in concentration history but a significant difference at the 10% level between the average of 2A and 2B as compared to 2D. No significant difference was noted in interval mass removal from 2A and 2B, indicating parallel curves. Total mass removed from 2A at 1300 mm was only 9% greater than that removed from 2B. This removal rate was very comparable to that occurring in test cell 1 (5). Removal from 2D parallels that of 2A and 2B after 500-600 mm but was only 68% of the removal from 2A at 1500 mm.

Potassium

Analysis for potassium was done on all bi-weekly leachate samples. The

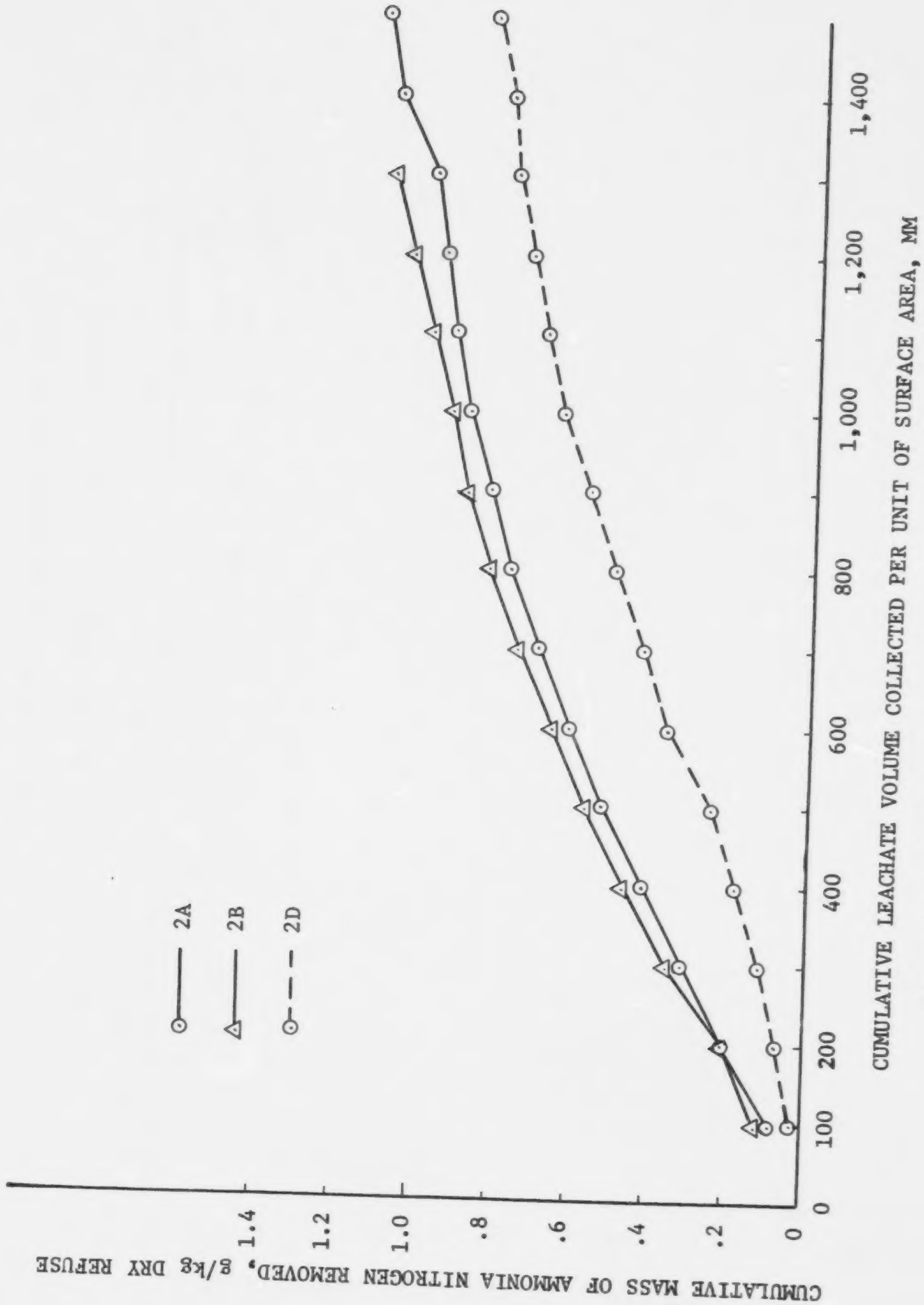


Figure 19. Cumulative ammonia nitrogen mass removal.

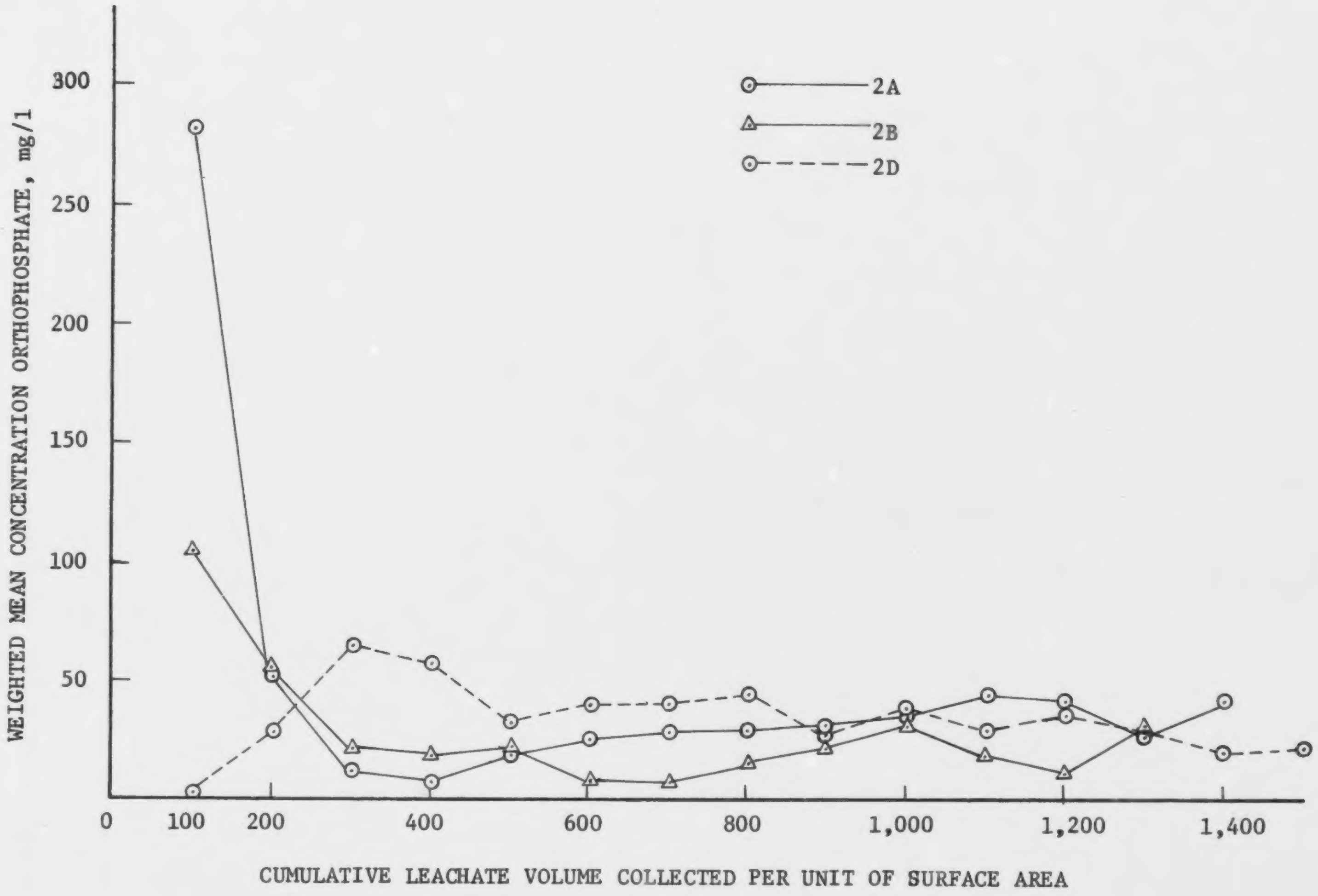


Figure 20. Weighted mean orthophosphate concentration.

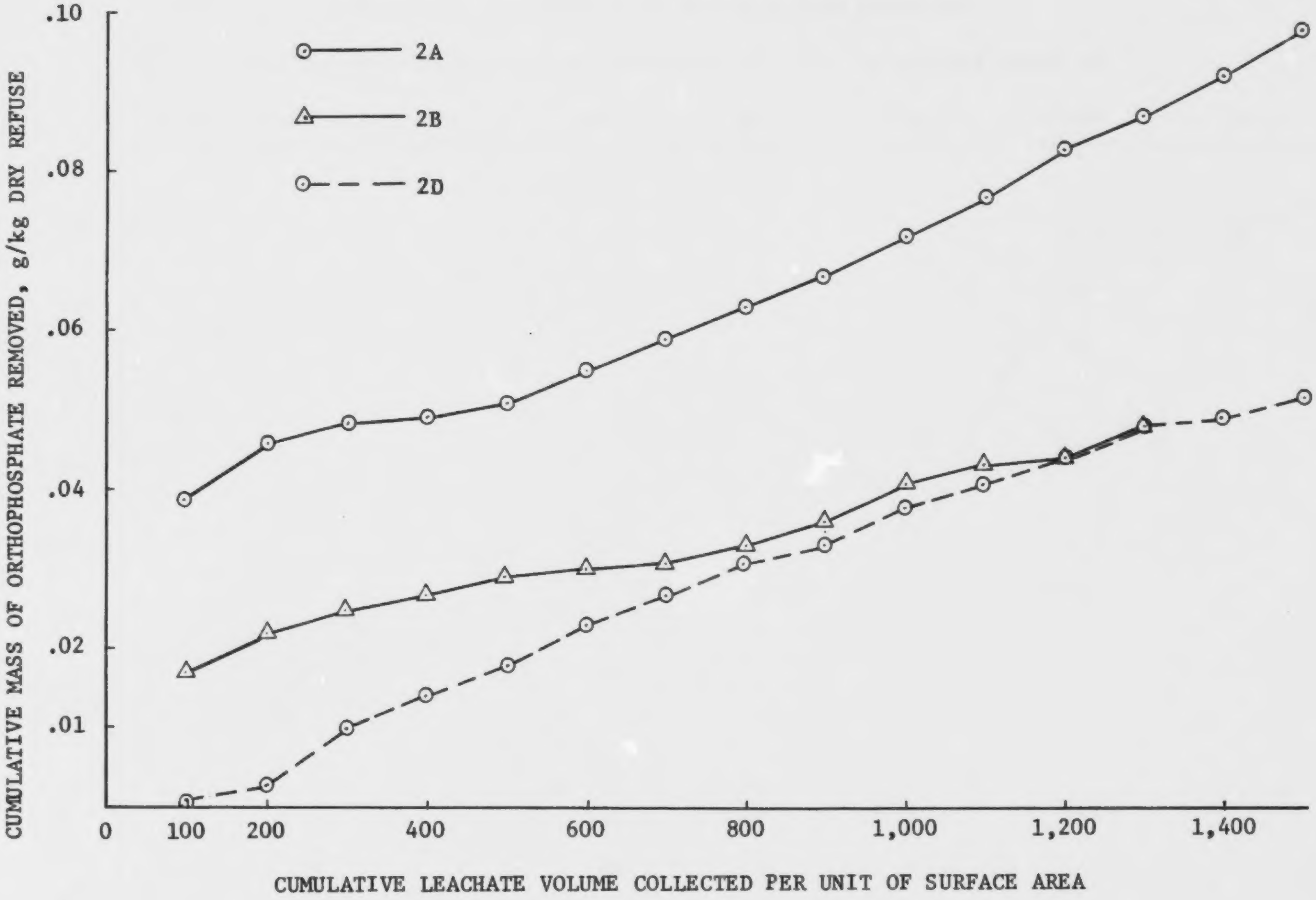


Figure 21. Cumulative orthophosphate mass removal.

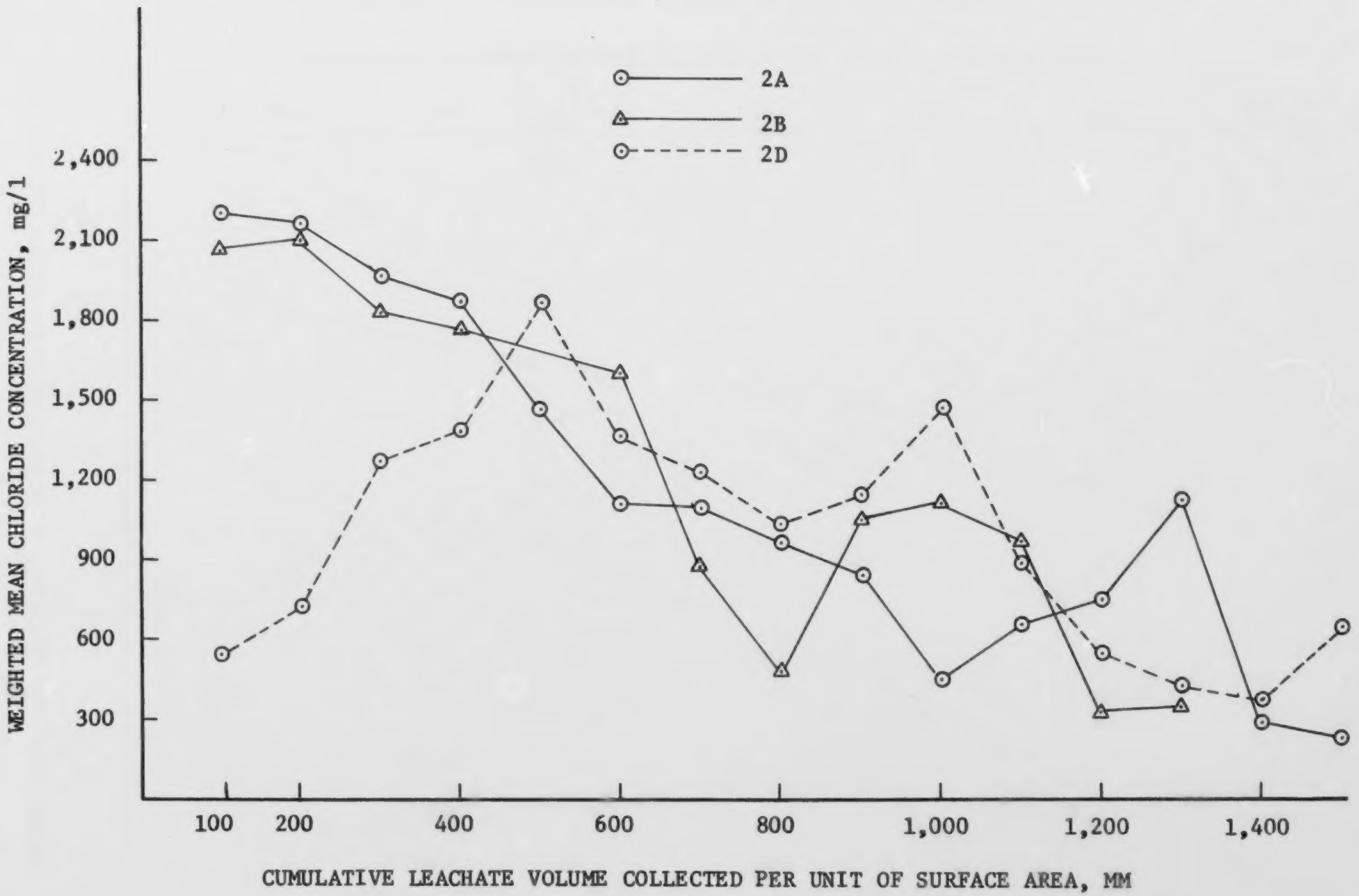


Figure 22. Weighted mean chloride concentration.

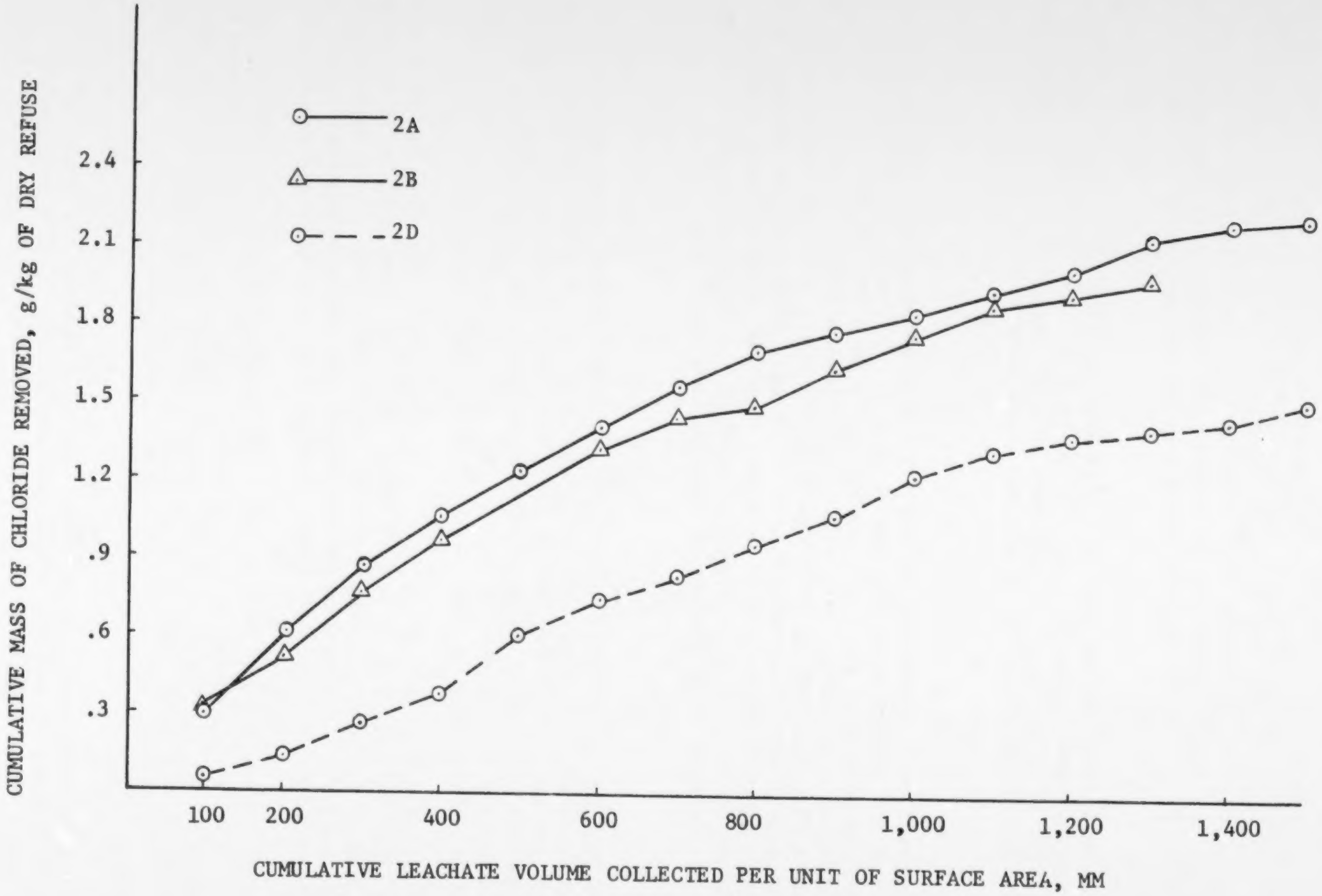


Figure 23. Cumulative chloride mass removal.

weighted mean concentration histories and cumulative mass removals are presented in Figures 24 and 25. The concentration history curves for 2A and 2B coincided very closely and there was no significant difference shown from the paired difference test. The average concentration of 2A and 2B compared to 2D showed a significant difference from 2D. The concentration history of 2D was similar to those previously discussed with a peak later than that of 2A and 2B and higher concentrations later in time and as volume collected increased.

Interval mass removal average difference testing showed no significant difference betweem 2A and 2B. At 1300 mm only 2% less potassium had been removed from 2B than from 2A. The mass removed from 2D over the entire 1500 mm was only 83% of that from 2A but the rates were similar after 600 mm.

Sodium

Weighted mean concentration history and cumulative mass removal curves for sodium are presented in Figures 26 and 27. Although 2A and 2B showed peaks at the same time and close resemblance after 900 mm they were found to be statistically different with a high average difference because of the 2B concentration values having been consistently lower than 2A. Both 2A and 2B were not significantly different from 2D though, even with the delayed peak and higher concentrations later in time. Interval mass removals showed a significant difference which resulted from 2B not being parallel to 2A and 31% higher removal from 2A than 2B through 1300 mm of leachate.

Calcium

Figures 28 and 29 depict the weighted mean concentration and cumulative mass removals with leachate volume per unit of cell surface area for calcium. The peak concentrations for 2A and 2B were spread over a longer time period than previous parameters. The peak concentration for 2D was delayed until after the peaks for 2A and 2B. After 500 mm, all three cells tended to have decreasing concentrations down to the 600-900 mg/l range at 1500 mm.

Statistically, cell 2A differed from 2B and was not significantly different from 2D, and cell 2B was different from 2D. The similarity in 2A and 2D was caused by lower initial concentrations and higher later concentrations in 2D, resulting in a low average difference and statistical similarity, but not necessarily similarity of shape or magnitude when compared graphically.

Mass removal from 2A was not significantly different from 2B, on the interval analysis, indicating the curves were parallel. There was only 17% difference in total removal at 1300 mm. The mass removed per unit weight of dry refuse from 2D was lower than from 2A or 2B by about 40%.

Magnesium

The magnesium mean concentration and mass removal histories are presented in Figures 30 and 31. The peaks for 2A and 2B were recorded at the 250 mm point but there is a large variation in the magnitude of the peaks,

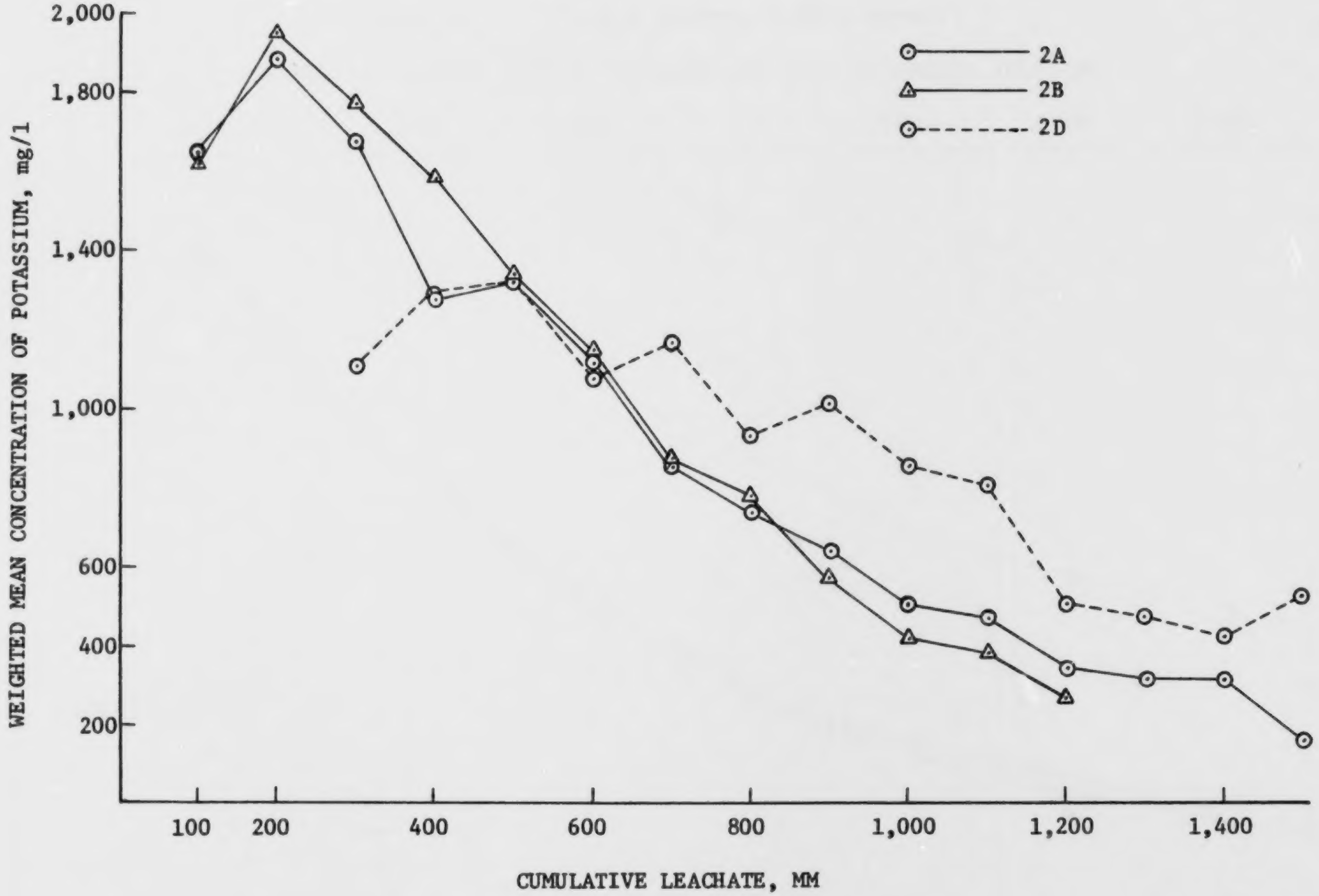


Figure 24. Weighted mean potassium concentration.

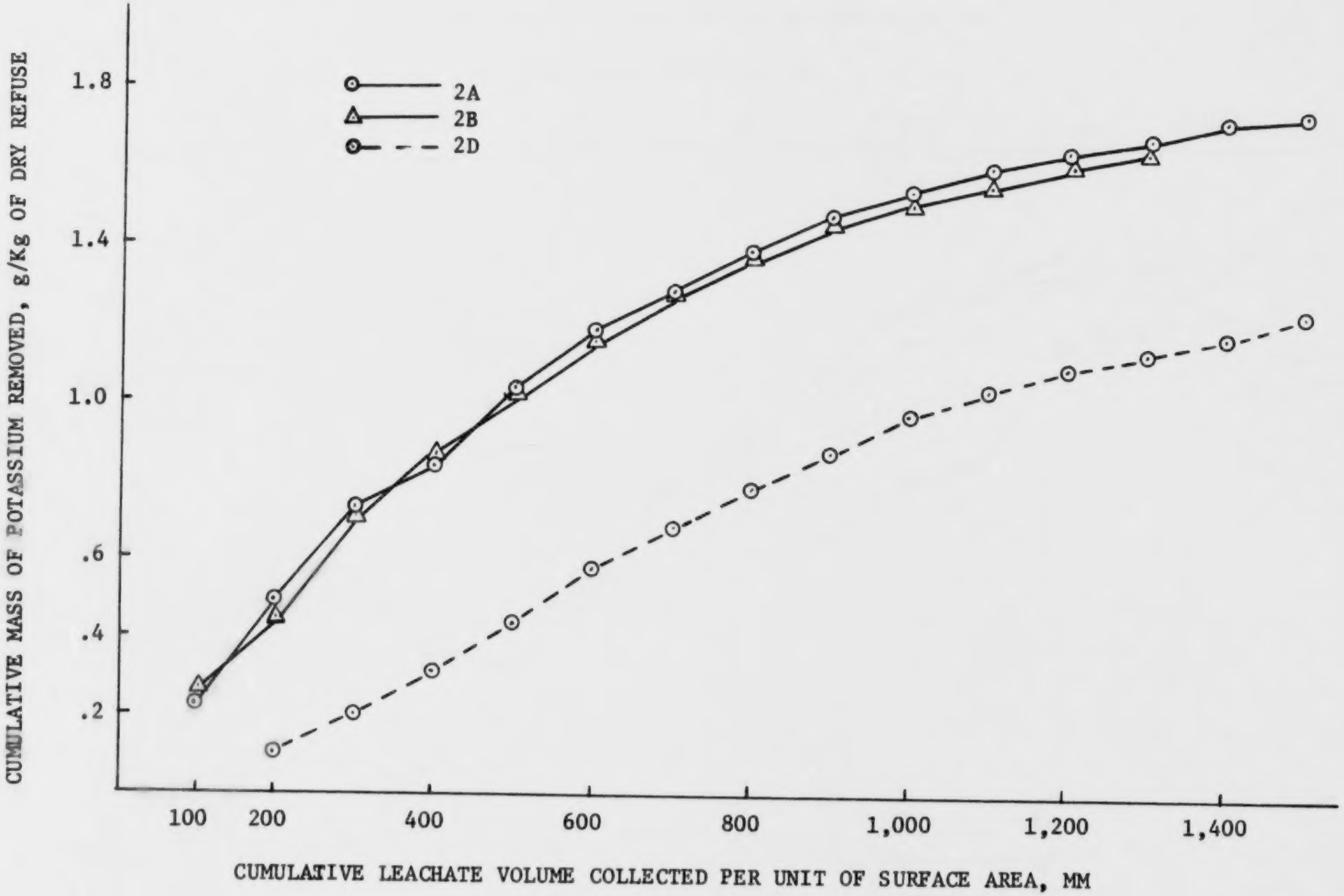


Figure 25. Cumulative potassium mass removal.

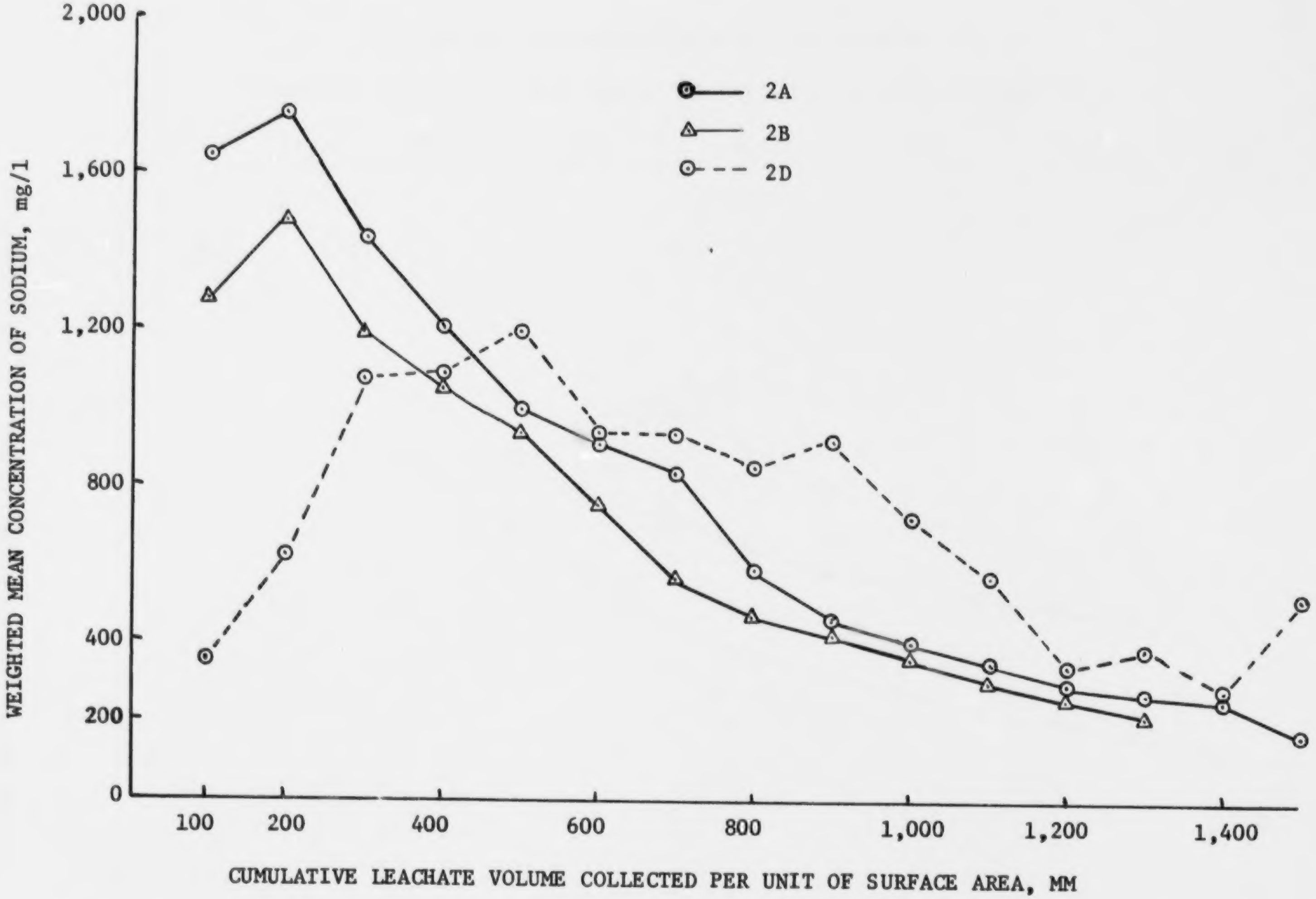


Figure 26. Weighted mean sodium concentration.

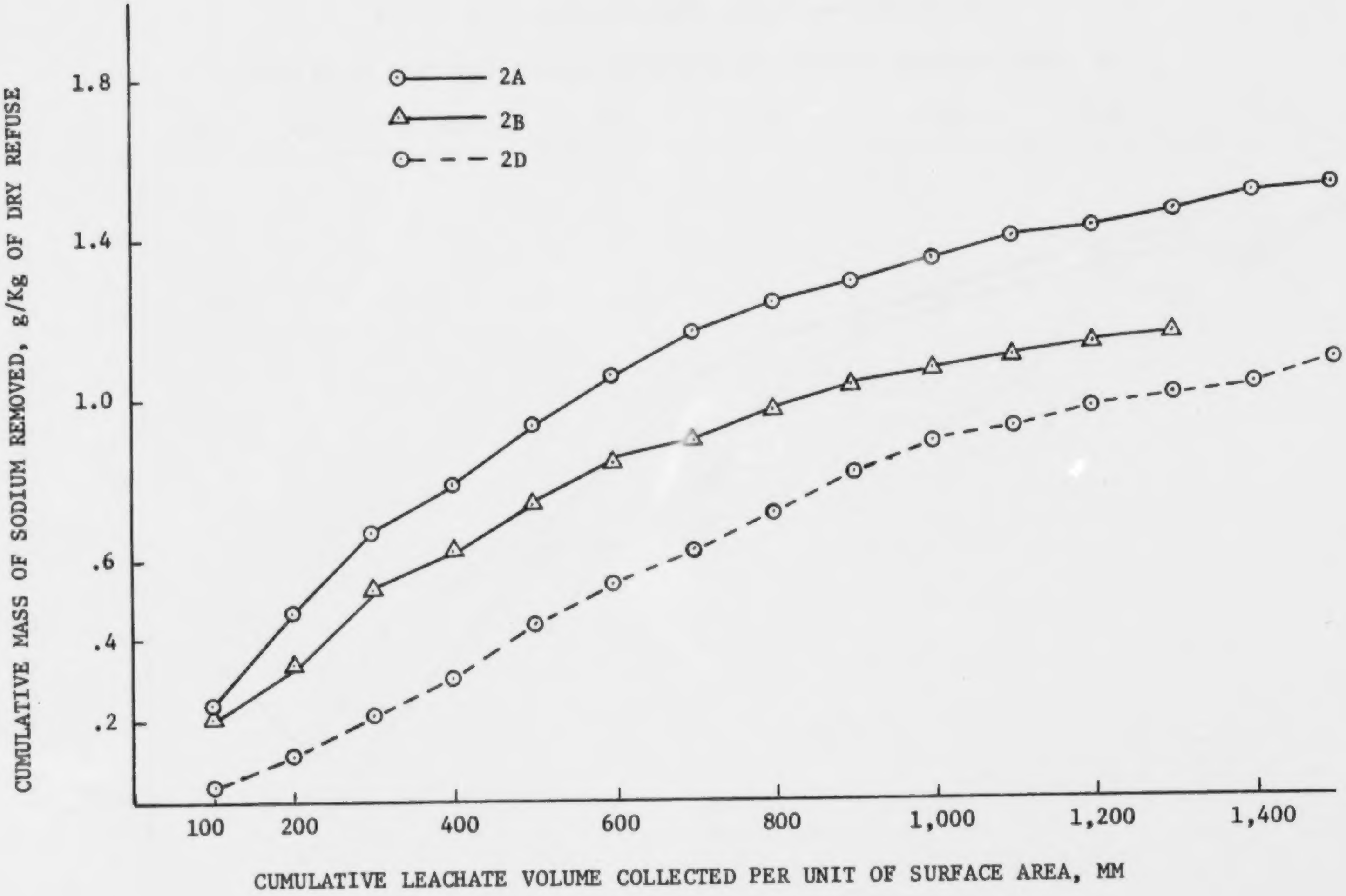


Figure 27. Cumulative sodium mass removal.

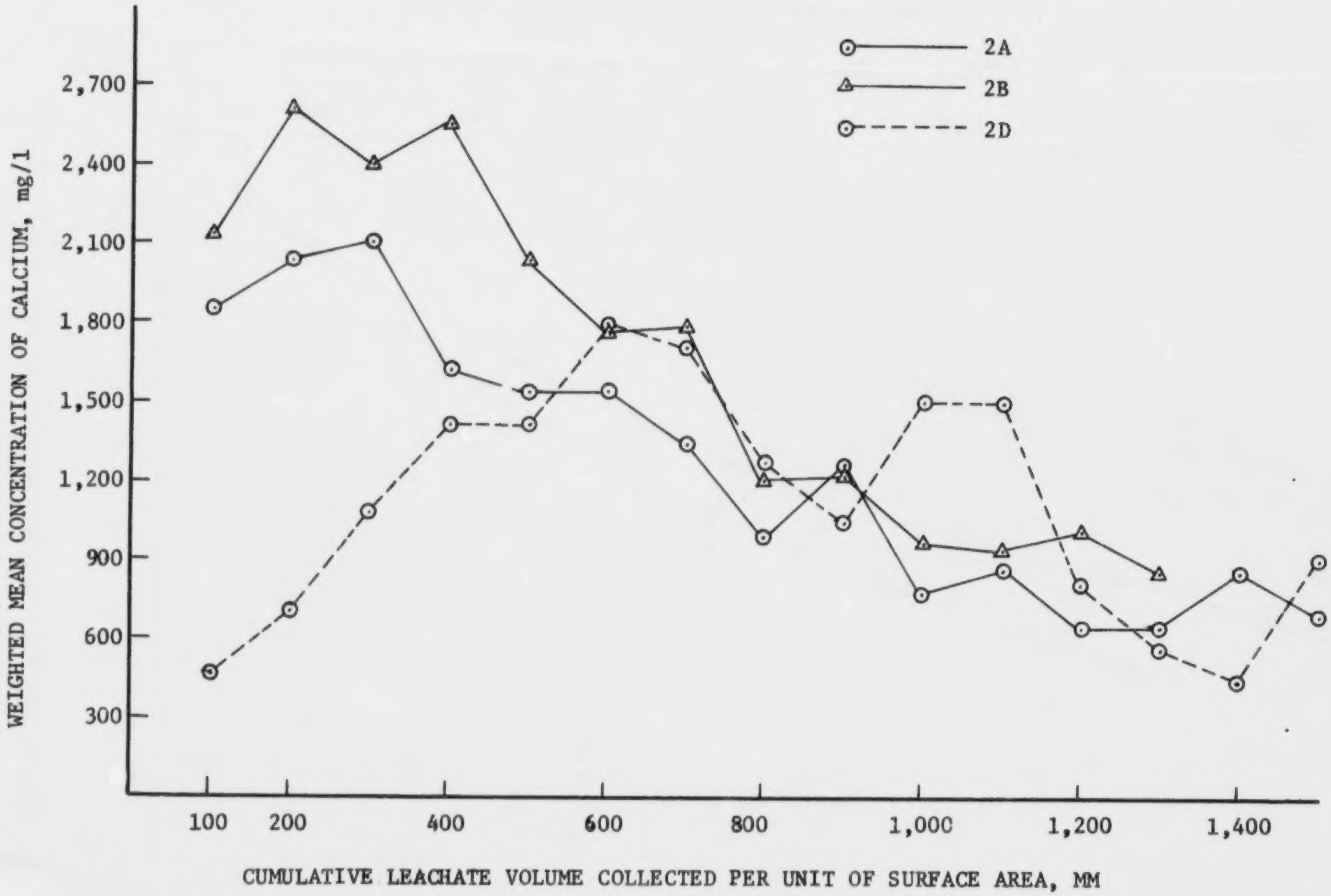


Figure 28. Weighted mean calcium concentration.

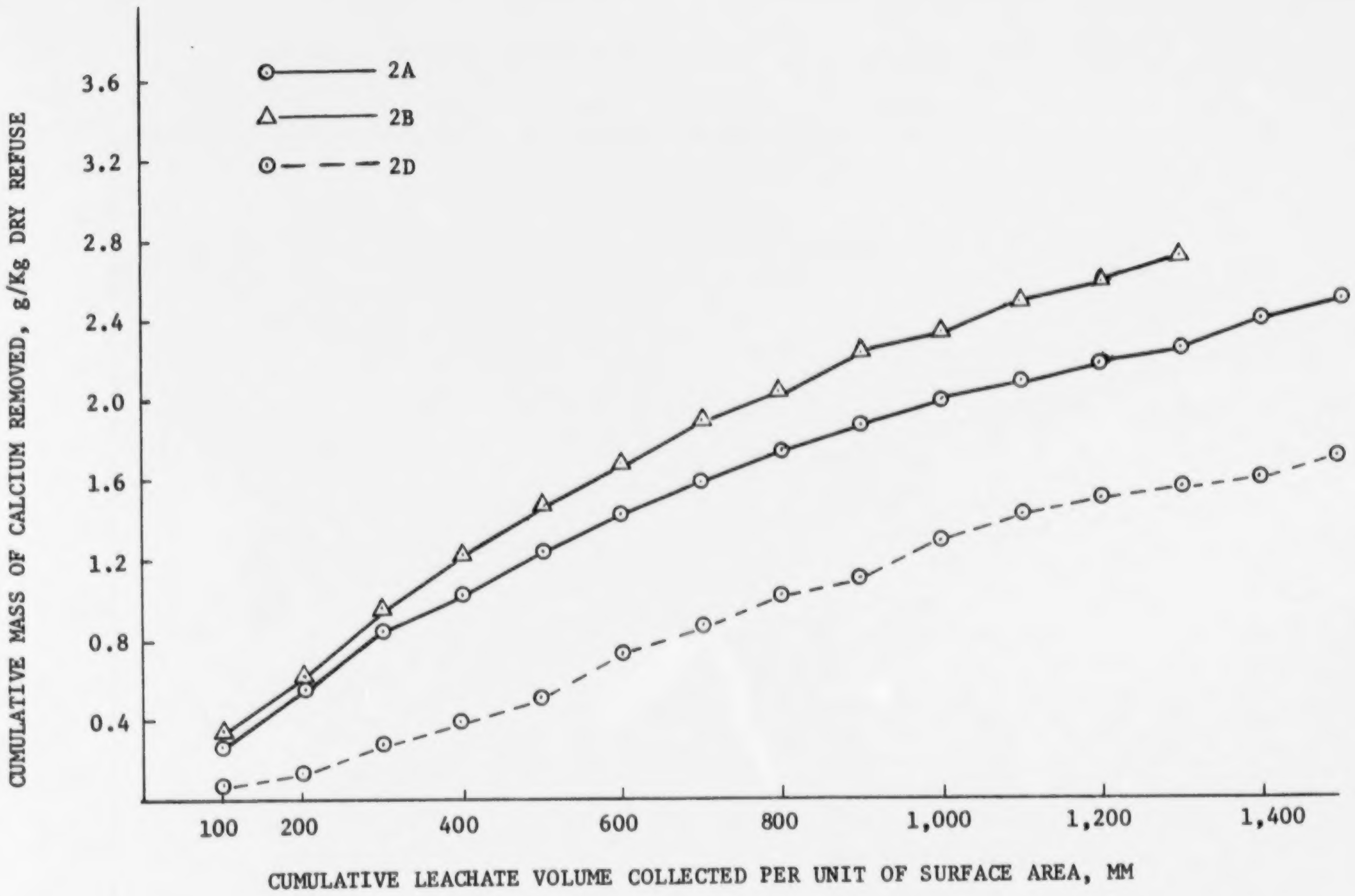


Figure 29. Cumulative calcium mass removal.

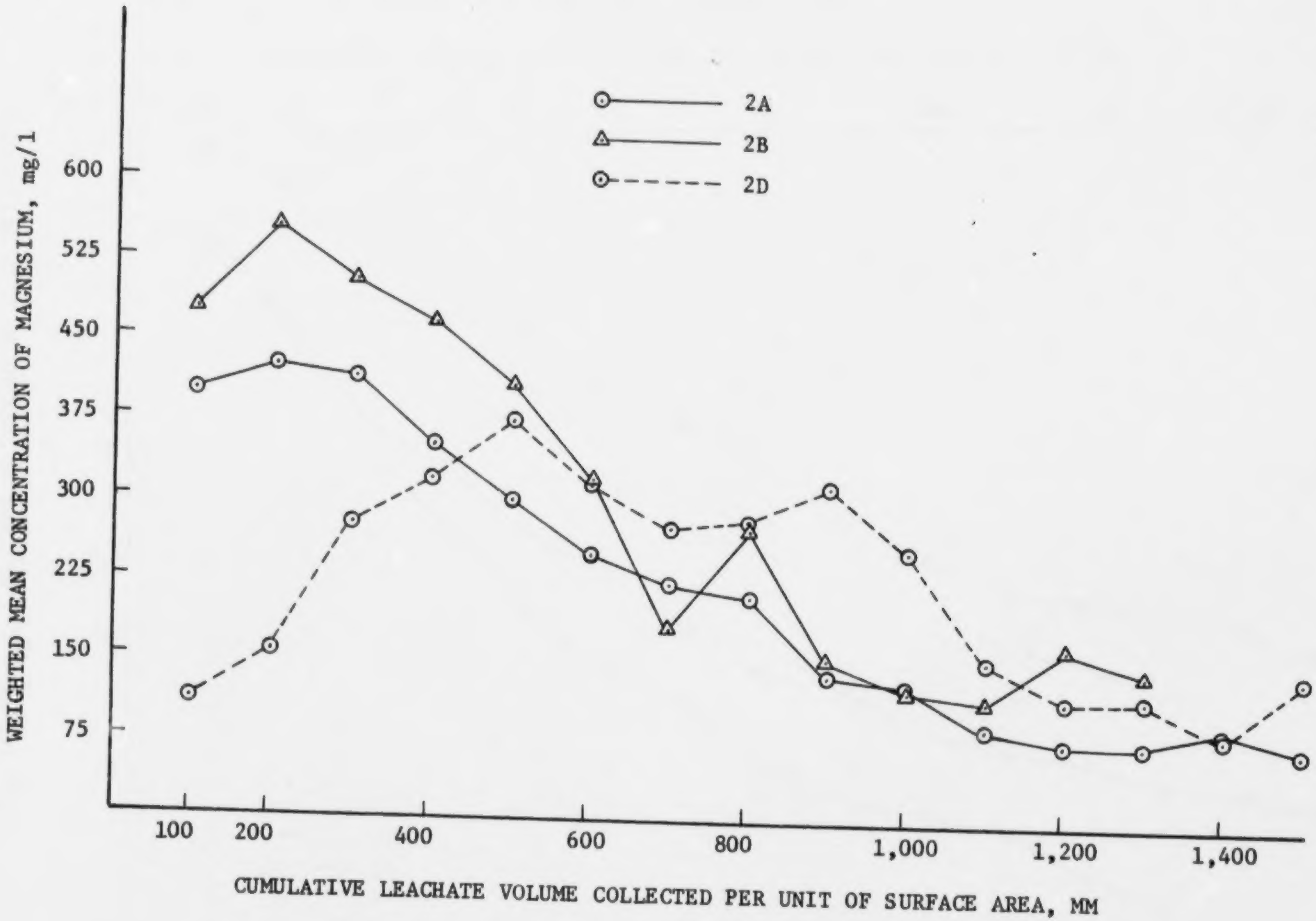


Figure 30. Weighted mean magnesium concentration.

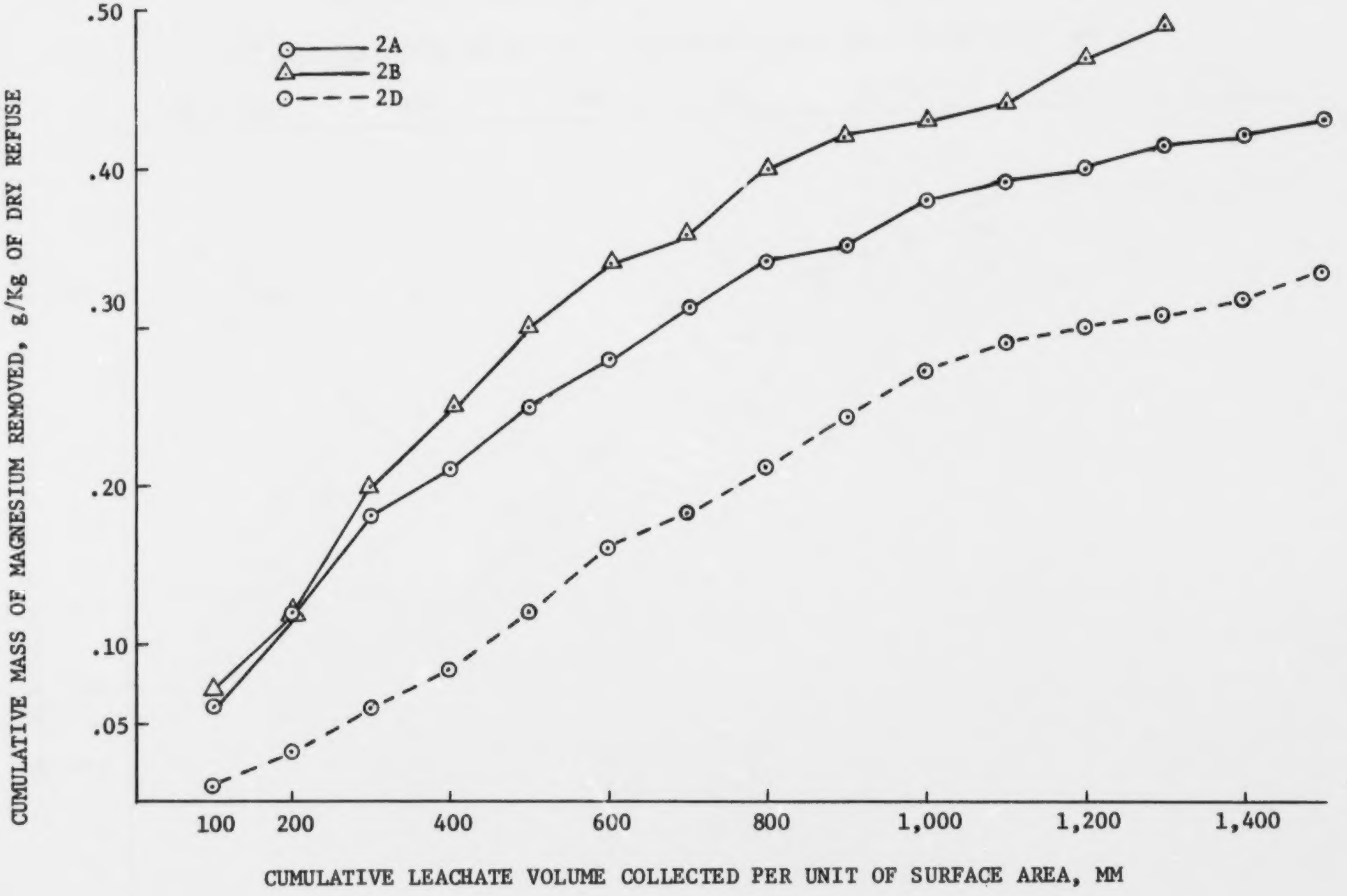


Figure 31. Cumulative magnesium mass removal.

2B being 32% higher. Paired difference testing of the weighted mean concentrations of 2A and 2B showed a highly significant difference as a result of 2B generally having higher concentration throughout the entire testing period. 2A was comparable to 2D; the statistical test showed no significant difference. This resulted from the same pattern as with calcium, 2D having been lower through the initial flow and then higher later in the study. All curves showed a marked downward trend, with final weighted mean concentrations of only 18-39% of peak values.

There was a significant difference in interval mass removal between 2A and 2B. 2D lagged in total quantity removed but roughly paralleled the rate of removal in 2A and 2B after 500 mm of leachate volume.

Iron

Figures 32 and 33 depict the weighted mean iron concentration and the cumulative mass removal. Although statistically the weighted mean concentration histories of iron for 2A and 2B were significantly different, caused by 2B being higher than 2A throughout most of the data, the resultant curves were remarkably similar. There was no significant difference between 2A and 2B in the interval mass removal test.

Concentration history difference analysis for both 2A and 2B as compared to 2D showed no significant difference although the curves were visibly dissimilar. This was again cuased by lower concentrations in 2D at the outset followed by higher concentrations after 400 mm.

Hardness

Hardness, shown in Figures 34 and 35, showed a significant difference statistically between 2A and 2B because 2B concentrations were higher for all but the initial 100 mm data point. The leachate volumes at peak did not coincide either. Only test cell 2A was not significantly different from the weighted mean concentration of 2D. This was once again the result of lower 2D values initially and higher values after 500 mm of leachate volume.

The cumulative mass removal rates for 2A and 2B were significantly different when compared on an interval basis. Mass removal for 2D per unit weight of dry refuse was 35% greater for 2A than 2D at 1500 mm. All three cells showed only slow drops in removal rates which indicated large quantities of hardness were yet to be removed.

Manganese

The weighted mean concentration and mass removal histories for the cells is shown in Figures 36 and 37. Concentrations for 2A and 2B were very similar and the paired difference analysis showed no significant difference. The average of 2A and 2B weighted mean concentrations was also not significantly different from 2F, once again due to the early lower values and later higher values for 2D.

The interval mass removal from 2A compared to 2B showed no statistical

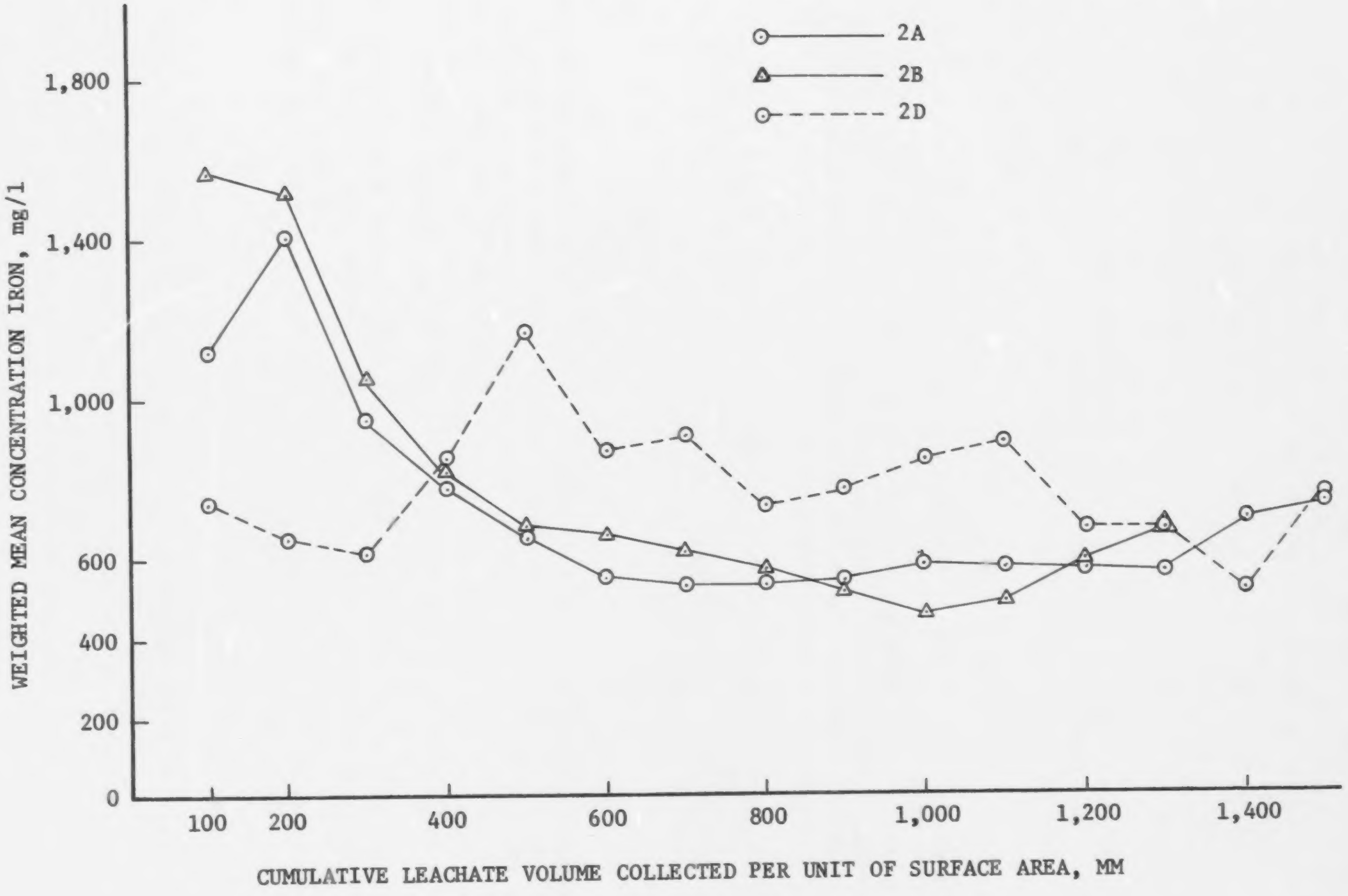


Figure 32. Weighted mean iron concentration.

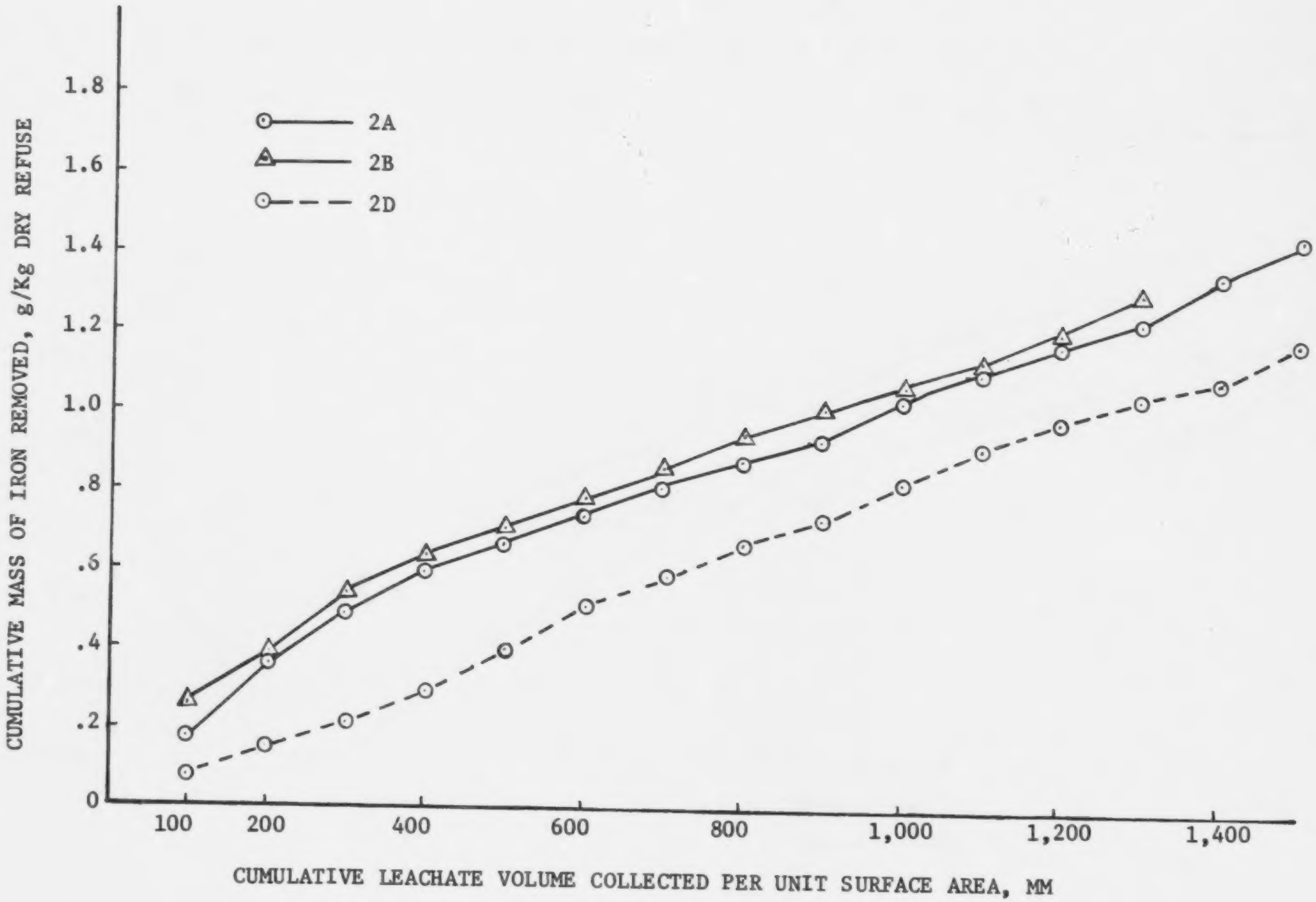


Figure 33. Cumulative iron mass removal.

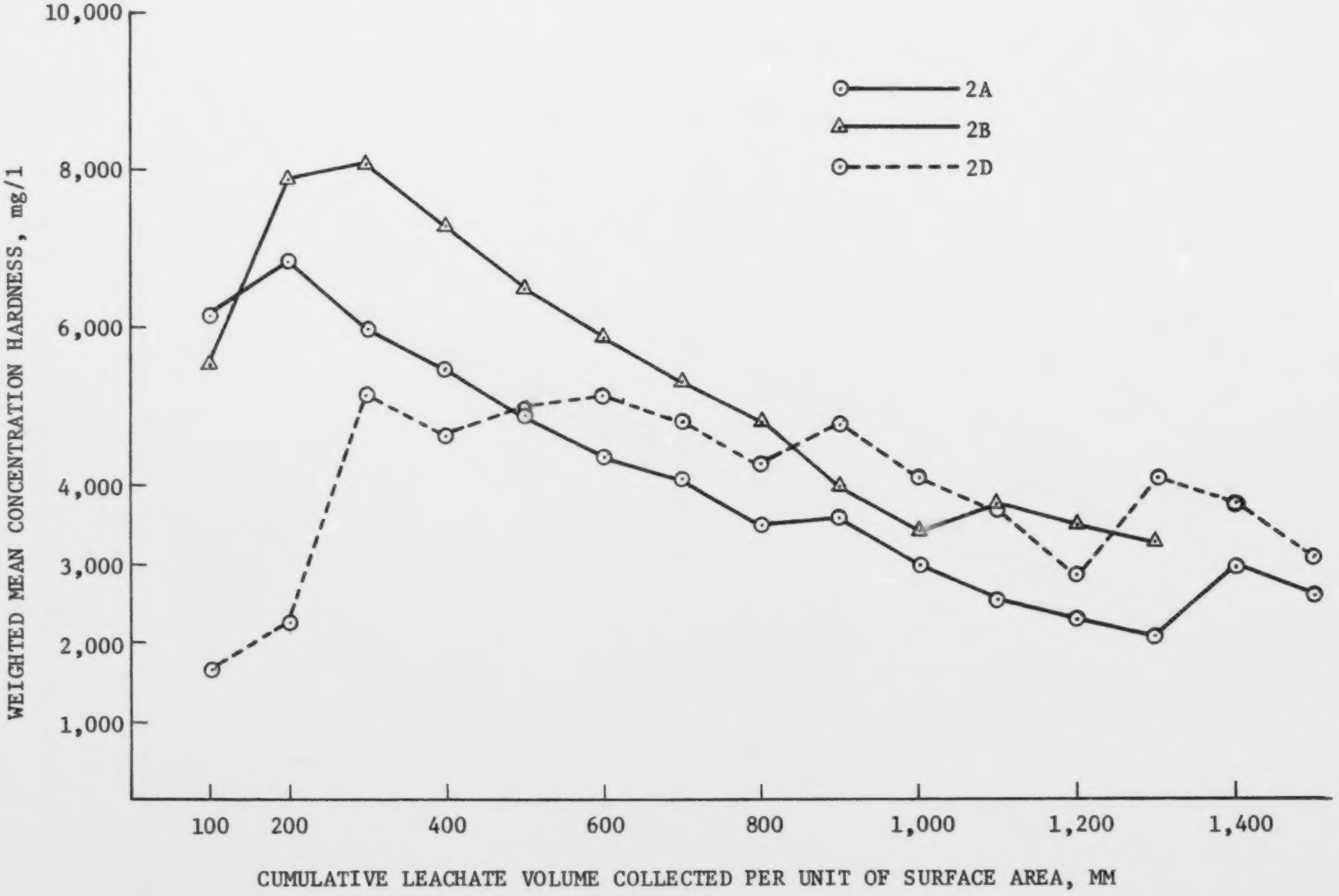


Figure 34. Weighted mean hardness concentration.

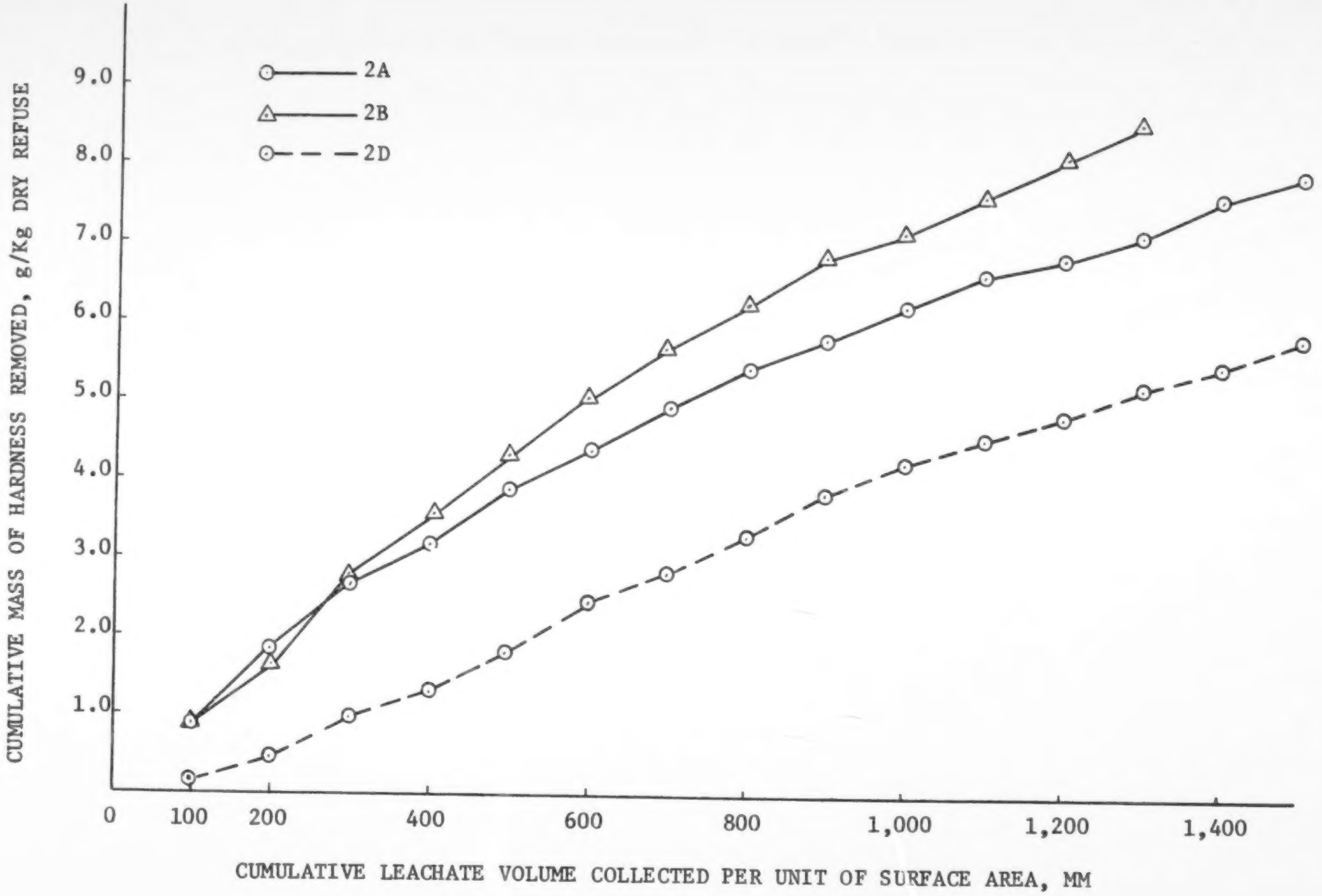


Figure 35. Cumulative hardness mass removal.

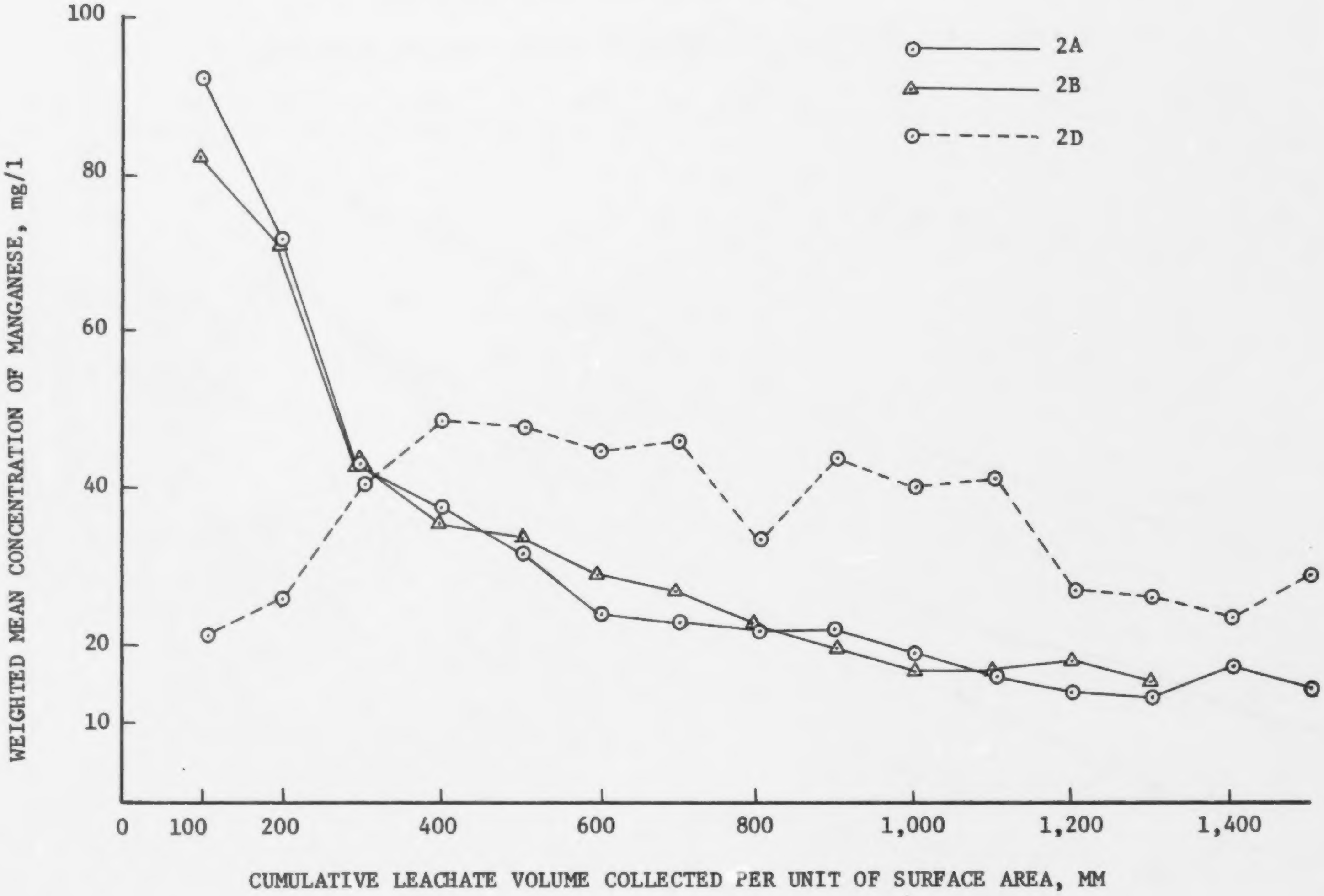


Figure 36. Weighted mean manganese concentration.

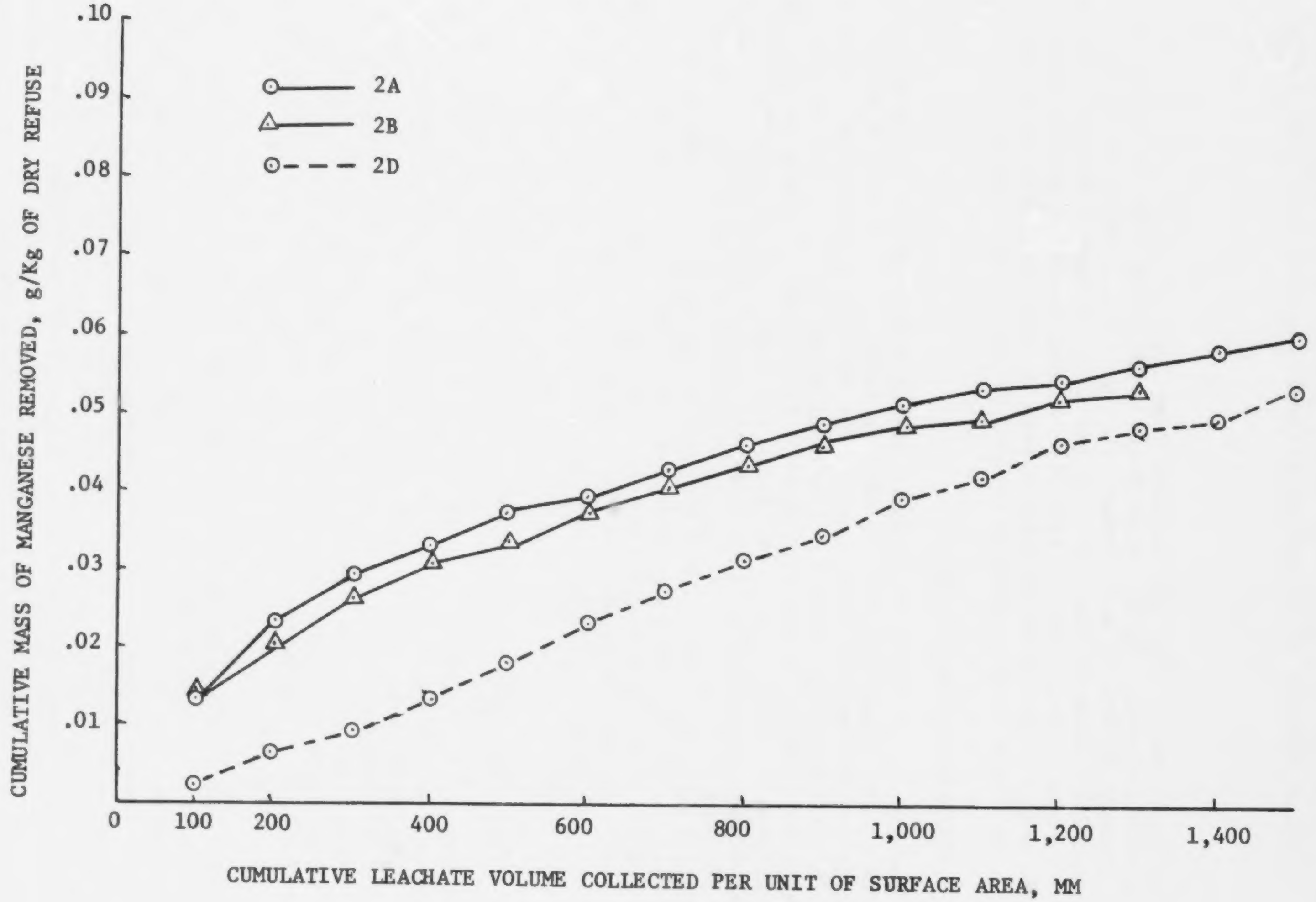


Figure 37. Cumulative manganese mass removal.

significant difference although 2B does fall lower than 2A through the entire leachate volume collected. The mass removed from the large cell 2D lagged 2A and 2B but the difference diminished with increased leachate collected.

Zinc

Figures 38 and 39 show the weighted mean concentrations and cumulative mass removals for zinc. 2A was significantly different from 2B in concentration history as were 2A and 2B when compared to 2D. There was also a significant difference statistically in the interval mass removals of 2A and 2B. The greater mass removal of zinc from 2B and the shape of the curve seemed to indicate an initially soluble mass of zinc available in 2B but not in 2A or 2D. Total removal from 2B at 1300 mm was 372 g of zinc.

Leachate Statistical Comparibility

A summary of the statistical test results comparing the concentration histories of the parameters is presented in Table 13. For only 4 of 14 parameters was the average difference of the concentration history curves of 2A and 2B not significant at the 10% level through the 0 - 1,300 mm range. Of these four there is no trend indicated, such as all divalent cations not being different. While 71 percent of the parameters tested indicated test cells 2A and 2B were statistically different (based on the test used) examination of the COD concentration history (Figure 12), as an example, showed very similar responses for the two test cells and closer examination reveals consistently smaller concentrations for 2A as compared to 2B. This data pattern results in a small standard deviation, which when divided into the average algebraic difference of the data points, yields a high t_{calc} or significant difference. The applicability of this statistical test is therefore questionable.

The same statistical analysis was used to compare either the average concentrations of cells 2A and 2B to 2D when there was no significant difference between 2A and 2B, or the concentration of 2A to 2D and of 2B to 2D when the paired difference test indicated a significant difference between 2A and 2B. These results are presented in the final 6 columns of Table 13. Again, no trend was established although in the comparison of 2A to 2D a greater percentage were not significantly different than in the comparison of 2A to 2B. This would not be expected since the flow of water through 2D in comparison to 2A has been much greater than the difference between 2A and 2B.

A total of 9 of the 14 selected parameters showed no significant difference for the average of 2A and 2B or 2A as compared to 2D. Of the remaining 5 parameters only COD showed a highly significant difference or had a large confidence interval. This indicated that cell 2A statistically provided a reasonable model of 2D for many parameter concentration histories. This is not the situation for 2B where only 6 of the 14 parameters showed no significant difference. Since most of the parameter histories for 2A and 2B were not statistically similar, based on the results of this test it would be inaccurate to state that any model of a large-scale cell would provide as

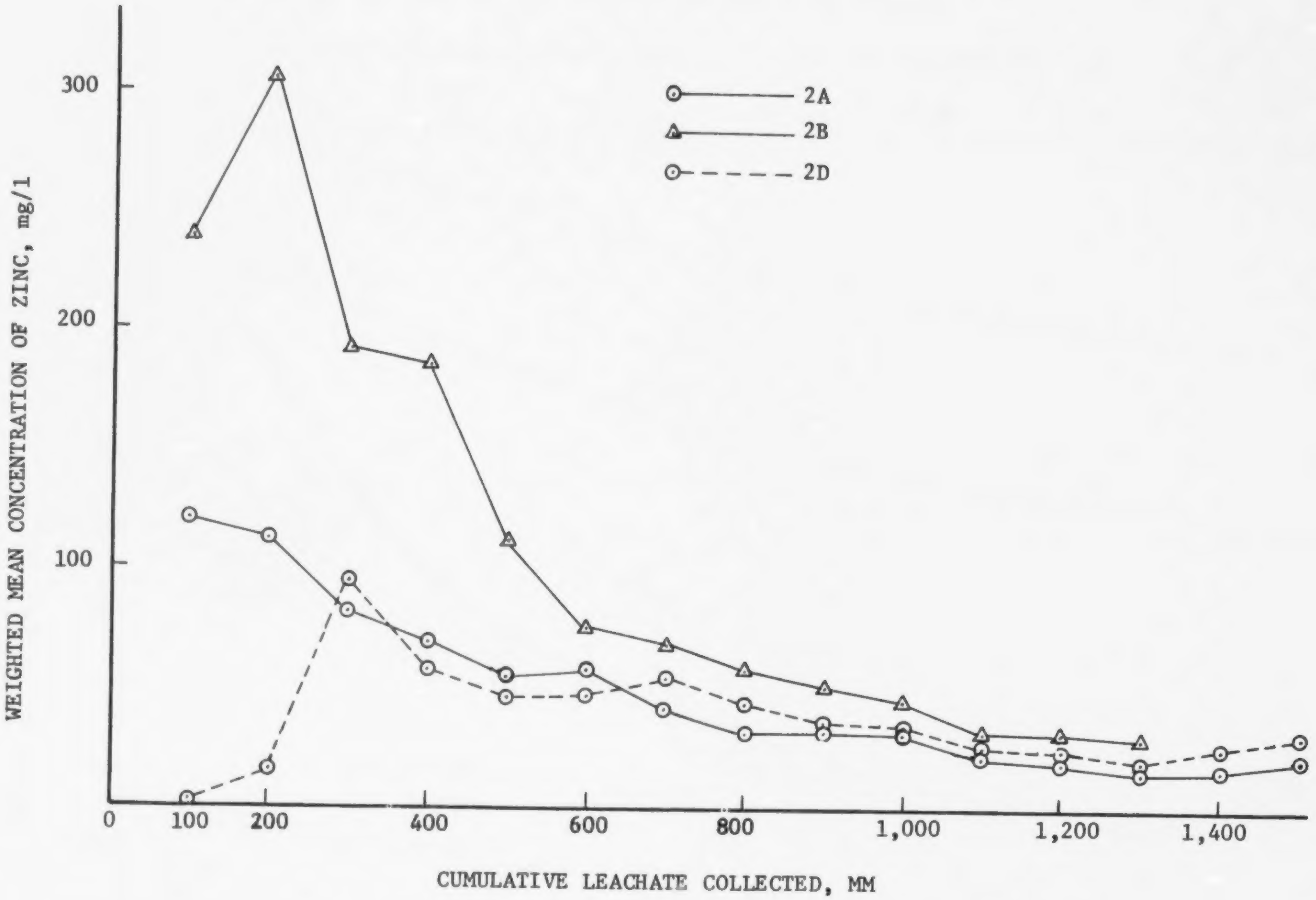


Figure 38. Weighted mean zinc concentration.

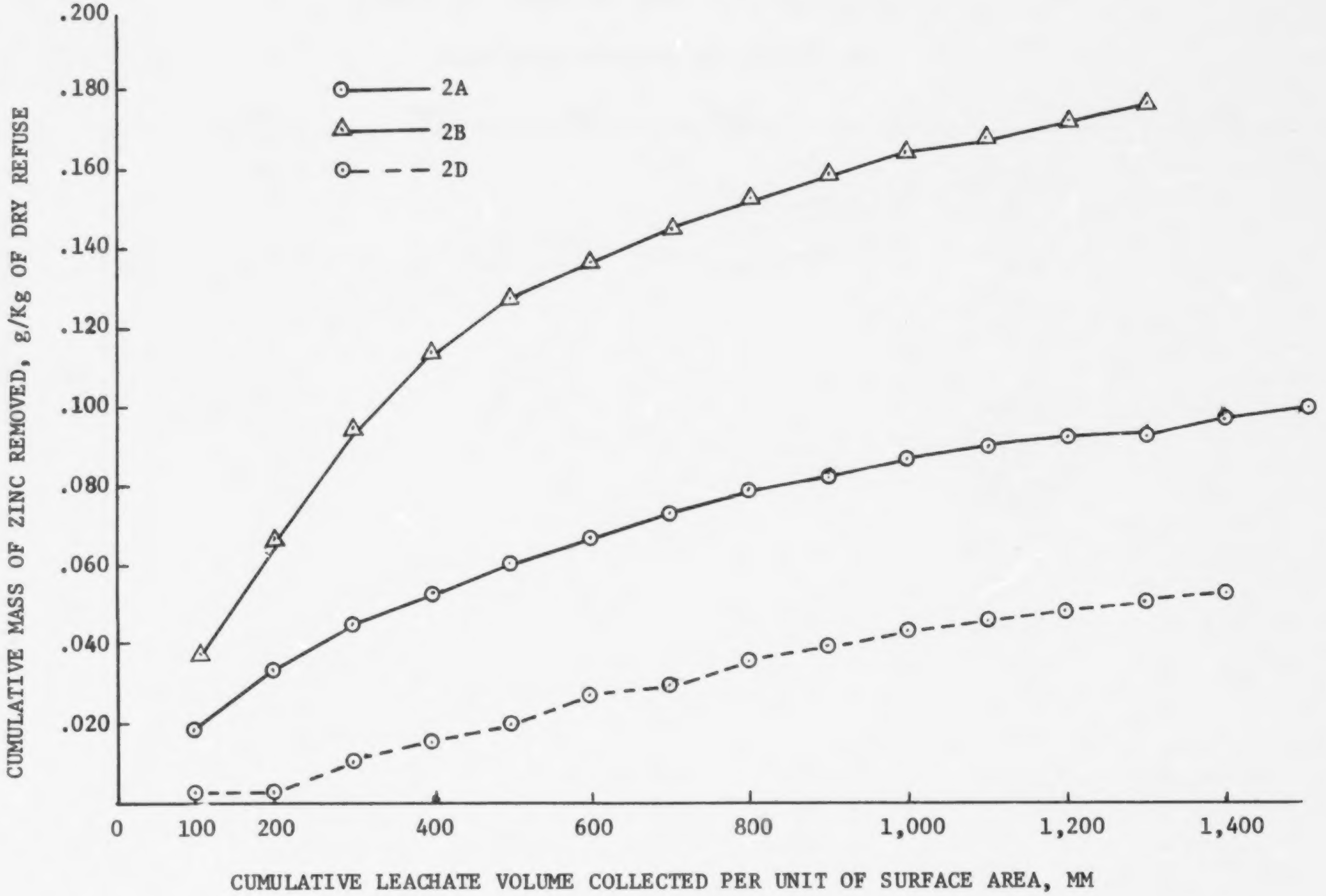


Figure 39. Cumulative zinc mass removal.

TABLE 13. WEIGHTED MEAN CONCENTRATION HISTORIES - PAIRED DIFFERENCE TEST RESULTS

	2A-2B	2A-2B	$\frac{2A+2B}{2} - D$	$\frac{2A+2B}{2} - D$	2A-2D	2A-2D	2B-2D	2B-2D
Parameter	t_{calc}[a]	t_{10}[b]	t_{calc}	t_{10}	t_{calc}	t_{10}	t_{calc}	t_{10}
COD	3.82	1.83	-	-	5.00	1.83	7.70	1.83
Sulfate	2.17	1.83	-	-	0.98	1.83	0.47	1.83
K-Nitrogen	4.15	1.83	-	-	1.97	1.83	3.92	1.83
Ammonia-N	1.64	1.83[c]	1.31	1.83	-	-	-	-
Orthophosphate	2.51	1.83	-	-	.921	1.83	1.24	1.83
Chloride	.943	1.86	2.87	1.86	-	-	-	-
Potassium	1.25	1.83	2.14	1.83	-	-	-	-
Sodium	8.87	1.83	-	-	1.59	1.83	1.70	1.83
Calcium	5.33	1.83	-	-	1.69	1.83	5.55	1.83
Magnesium	10.0	1.83	-	-	.321	1.83	3.44	1.83
Iron	2.89	1.83	-	-	1.45	1.83	.259	1.83
Hardness	8.35	1.83	-	-	0.79	1.83	5.52	1.83
Manganese	.354	1.83	1.40	1.83	-	-	-	-
Zinc	7.50	1.83	-	-	2.26	1.83	5.80	1.83

a. t_{calc} - calculated by division of the average difference by the standard deviation of the average differences.

b. t_{10} - tabular t from Reference 6.

c. Underscored values shows no statistically significant difference.

close a resemblance as 2A has to 2D.

Since the data used in the paired difference tests were actually weighted means at 100 mm intervals, paired difference tests were conducted using the actual data from every fourth sample to determine if using the weighted means might possibly have biased the analysis. The results of these tests on selected parameter concentration histories are shown in Table 14. A significant difference was found for all 6 of the parameters using actual data and for all but one of these the confidence interval was larger than that of the weighted mean history curves. The results shown in Table 13 might therefore be biased as they are not necessarily representative of the actual data. No tests were made that included all of the actual data.

Many of the weighted mean concentration history curves, Figures 12-39, showed a later peak concentration for cell 2D than for 2A or 2B then resonably close or slightly higher concentrations. Since this early large variation in concentrations and time to peak might have influenced the results of the paired difference tests, additional difference analyses were done for the data points on the concentration history curves for 2A and 2D beginning at the peak of the concentration of 2D rather than at the 100 mm data point. These results are presented in Table 15. The results did not show as good agreement as the tests using the entire data history. Only 3 of the 13 parameters did not show a significant difference. It is interesting to note that all of these three, COD, chloride and zinc, were significantly different over the entire data range (Table 13).

Paired difference testing was also done on the cumulative mass removal curves through 1,300 mm. The results for selected parameters with closely coinciding curves are presented in Table 16. All showed a significant difference, even when two curves almost coincided throughout the entire leachate volume range. While two curves might almost coincide, for example COD, Figure 13, normally one (2A or 2B) was just above the other. This resulted in a small average difference, but a very small standard deviation, a large t_{calc} and a significant difference.

To overcome this weakness of the test, the gain in mass removal for each 100 mm interval for 2A was compared to that gain for 2B. These paired difference test results are presented in Table 17. This provided a different perspective into the closeness of the cumulative mass removal curves for 2A and 2B with 9 of the 14 parameters showing no significant difference. Four of the remaining parameters had relatively small confidence intervals.

These results contrasted with the concentration history results in Table 13, where only 4 of the 14 parameters showed no significant difference. Apparently 2A and 2B were relatively similar in mass removal but not so in concentration histories. This indicated that the removal of these substances from the refuse in 2A and 2B was limited by the amount of the substance readily available for leaching at that time period in the decomposition process. That is the leachate production varied within some range, and the concentration varied from cell to cell, but the mass removal during each interval was comparable.

TABLE 14. ACTUAL CONCENTRATION HISTORIES - PAIRED DIFFERENCE TEST RESULTS

Parameter	Actual Data 2A-2B t_{calc}[a]	Actual Data 2A-2B t_{10}[b]	Result
COD	9.88	1.74	Significant Difference
Sulfate	5.70	1.75	Significant Difference
Chloride	1.96	1.78	Significant Difference
Sodium	4.83	1.78	Significant Difference
Iron	3.76	1.74	Significant Difference
Manganese	9.15	1.78	Significant Difference

a. t_{calc} - calculated by division of the average difference by the standard deviation of the average difference.

b. t_{10} - tabular t from Reference 6.

Application of the paired difference statistic to the leachate data led to the following observations:

1. Based incremental increases in masses of parameter removed, test cells 2A and 2B, were not significantly different except for orthophosphate, sodium, magnesium, hardness, and zinc. Similar analyses were not made for 2A or 2B compared to 2D or for leachate volume between the three test cells.

2. The statistic must be used carefully when evaluating the comparability of concentration or cumulative mass histories. While the majority of parameters showed significant differences between cells (except for 2A-2D), very similar data which were consistently and slightly different were determined to be significantly different because their standard deviation was small. Thus, cells 2A and 2B, designed to evaluate performance duplication of identically constructed and sized test cells were statistically determined to have performed differently. The test cells, however, did perform in a very similar manner.

3. The extent of the difference between test cells 2A and 2B should be used as a discriminator to determine whether 2D performed differently from 2A or 2B.

MATHEMATICAL DESCRIPTION OF LEACHATE CONCENTRATION HISTORY

The repetitive shape of the leachate concentration curves and similar volumes at peak concentrations for many of the parameters indicated that the weighted mean concentration history curves might be mathematically described.

TABLE 15. PAIRED DIFFERENCE TEST RESULTS, STARTING POINT AT TEST CELL 2D PEAK OF WEIGHTED MEAN CONCENTRATION HISTORY

Parameter	Starting Leachate Volume[a]	2A-2D t_{calc}[b]	2A-2D t_{10}[c]	Result
COD	500	1.39	1.94	Not Significant
Sulfate	500	10.2	1.94	Significant
K-Nitrogen	600	9.08	2.02	Significant
Ammonia-N	600	10.4	2.02	Significant
Orthophosphate	300	3.79	1.86	Significant
Chloride	500	1.55	1.94	Not Significant
Potassium	500	5.29	1.94	Significant
Sodium	500	5.87	1.94	Significant
Calcium	500	2.10	1.94	Significant
Magnesium	500	4.71	1.94	Significant
Iron	500	9.21	1.94	Significant
Hardness	300	4.50	1.86	Significant
Zinc	300	.983	1.86	Not Significant

a. millimeters - volume per unit of surface area

b. t_{calc} - calculated by division of the average difference by the standard deviation of the average difference

c. t_{10} - tabular t from Reference 6.

TABLE 16. CUMULATIVE WEIGHT HISTORY PAIRED DIFFERENCE TEST RESULTS

Parameter	2A-2B $t_{calc}{}^{b}$	2A-2B $t_{10}{}^{b}$	Results
COD	4.25	1.83	Significant
Sulfate	4.58	1.83	Significant
K-Nitrogen	1.96	1.83	Significant
Ammonia-N	14.2	1.83	Significant
Orthophosphate	63.6	1.83	Significant
Chloride	9.16	1.86	Significant
Potassium	3.14	1.83	Significant
Sodium	29.0	1.83	Significant
Calcium	27.3	1.83	Significant
Magnesium	17.9	1.83	Significant
Iron	8.82	1.83	Significant
Hardness	18.1	1.83	Significant
Manganese	7.21	1.83	Significant
Zinc	44.5	1.83	Significant

a. t_{calc} - calculated by division of the average difference by the standard deviation of the average difference

b. t_{10} - tabular t from Reference 6.

TABLE 17. INTERVAL MASS REMOVAL PAIRED DIFFERENCE TEST RESULTS

Parameter	2A-2B $t_{calc}{}^{a}$	2A-2B $t_{10}{}^{b}$	Results
COD	.522	1.833	Not Significant
Sulfate	.928	1.833	Not Significant
K-Nitrogen	.536	1.833	Not Significant
Ammonia-N	1.35	1.833	Not Significant
Orthophosphate	2.48	1.833	Significant
Chloride	.845	1.860	Not Significant
Potassium	.308	1.833	Not Significant
Sodium	2.78	1.833	Significant
Calcium	1.49	1.833	Not Significant
Magnesium	1.93	1.833	Significant
Iron	.494	1.833	Not Significant
Hardness	2.55	1.833	Significant
Manganese	.405	1.833	Not Significant
Zinc	10.0	1.833	Significant

a. t_{calc} - calculated by division of the average difference by the standard deviation of the average difference

b. t_{10} - tabular t from Reference 6.

Two previous efforts at a model based on leaching bed theory (7) (8) met with limited success. While a descriptive equation was not a part of the original experimental design it was felt that limited examination of this possibility might provide further insight into data trends and provide a means for comparison with other studies.

The leaching of substances from refuse can basically be thought of as the dissolving or suspension of soluble or leachable substances in water passing through the fill. The resultant concentrations in the leachate are dependent on many factors, not all of which are understood or known, especially the magnitude of influence the factors exert on resultant concentrations. Important variables might be the initial mass of a substance readily available for leaching, decomposition of refuse within the fill and subsequent additional mass availability, the pH, solubility limits, the rate of water throughput, decomposition or reduction of the leachate constituents during travel through the fill, the depth of the fill and cover soil effects within the fill. The number of variables involved and the lack of understanding of their effect on resultant leachate concentrations make a semi-empirical curve-fitting approach attractive as an initial effort.

The shape of the weighted mean concentration history curves compared favorably with the well known dissolved oxygen deficit equation widely used to describe the dissolved oxygen concentration in a stream subjected to an organic pollution loading and natural reaeration (9). This equation is a description of two consecutive first order reactions and has the form:

$$C = \frac{k_1C_i}{k_2-k_1}\left(e^{-k_1v}-e^{-k_2v}\right) \quad (1)$$

C is the concentration at any volume of leachate, k_1 and k_2 are rate constants and C_i is an unknown concentration related to the contaminant mass available in the refuse. The equation is in terms of v, the volume of leachate collected per unit of surface area, to coincide with the weighted mean data and the plotting of concentration versus volume. Since volume of leachate collected is some function of time, such as sinusoidal in a seasonal environment, the equation could be changed to a time dependent function.

Since C_i was unknown, to solve Equation 1 for the rate constants it was necessary to divide Equation 1 by itself when the values of C and v were known, resulting in the form:

$$C = C_{max} \frac{e^{-k_1v}-e^{-k_2}}{e^{-k_1v_{max}}-e^{-k_2v_{max}}} \quad (2)$$

C_{max} was selected to be the peak concentration on the weighted mean concentration history curves occurring at cumulative volume v_{max}. k_1 and k_2 were determined by trial and error for best visual fit to the 2A plot. The respective C_{max}, v_{max}, k_1 and k_2 for selected parameters are presented in

Table 18. The comparative concentration history plots are shown in Figures 40-44.

TABLE 18. EQUATION CONSTANTS

Parameter	C_{max}[a]	v_{max}[b]	k_1[c]	k_2[c]
COD	55,400	200	.00098	.0145
Sulfate	1,130	200	.00138	.0125
Chloride	2,205	100	.00120	.0350
Magnesium	425	200	.00150	.0120
Iron	1,409	200	.00062	.0170

a. mg/l
b. mm - volume per unit of surface area
c. 1/mm

With k_1 and k_2 known, it was possible to compute C_1 in Equation 1 and solve for the total mass of a parameter that might be leached, by integrating the equation through an infinite volume of leachate. The resultant total leachable mass in mg per unit of surface area was:

$$M = C_1/k_2 \quad (3)$$

The total mass per kilogram of dry refuse for test cell 2A obtained by using Equation 3 is listed in the first column of Table 19. The percent of this calculated total mass that had actually been removed at 1500 mm of leachate is presented in the second column.

TABLE 19. CELL 2A - TOTAL AVAILABLE MASS REMOVALS

Parameter	Available Total Mass[a]	Removal at 1500 mm[b]
COD	89.6	70
Sulfate	1.41	75
Chloride	2.73	81
Magnesium	.500	86
Iron	3.26	31

a. g/Kg of dry refuse

b. percent removed obtained by dividing mass actually removed at 1500 mm by total mass calculated from Equation 3.

A reasonably good visual fit was obtained with Equation 2 for four of the parameters. It was not possible with this equation to describe the concentration behavior of iron because of the rapid fall after peak. This also happened

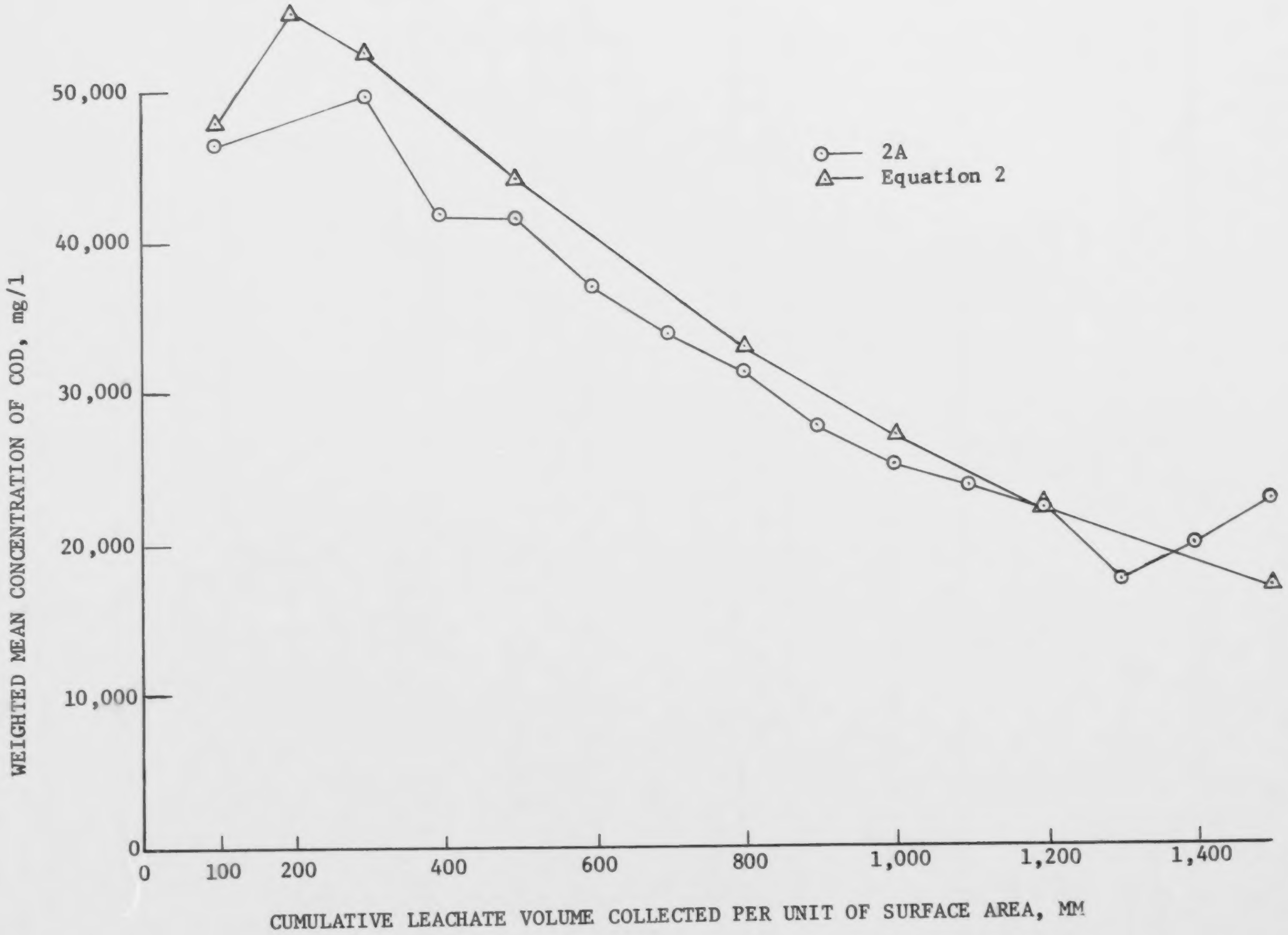


Figure 40. Weighted mean COD concentration history: Eqn. 2 - 2A.

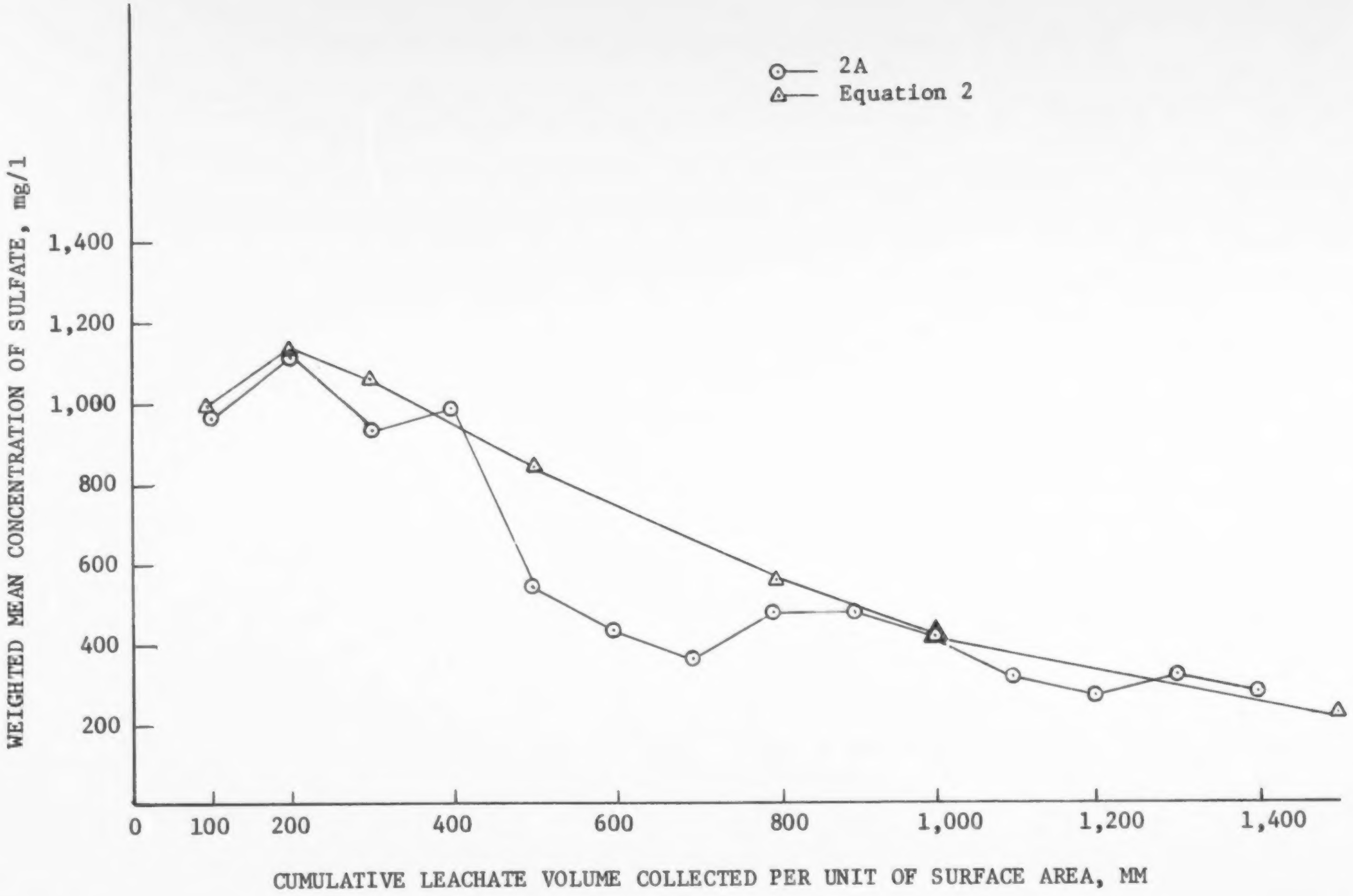


Figure 41. Weighted mean sulfate concentration history: Eqn. 2 - 2A.

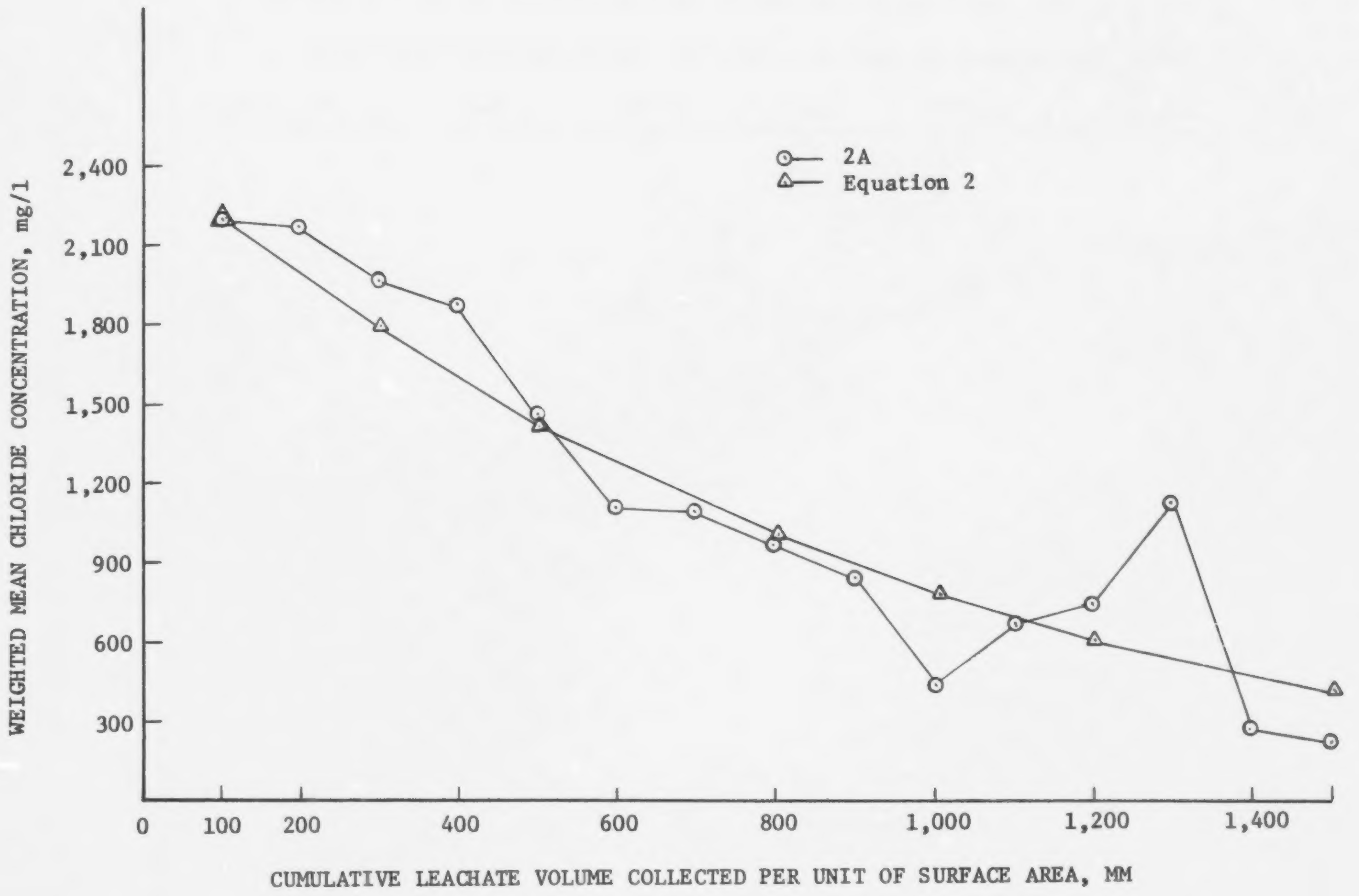


Figure 42. Weighted mean chloride concentration history: Eqn. 2 - 2A.

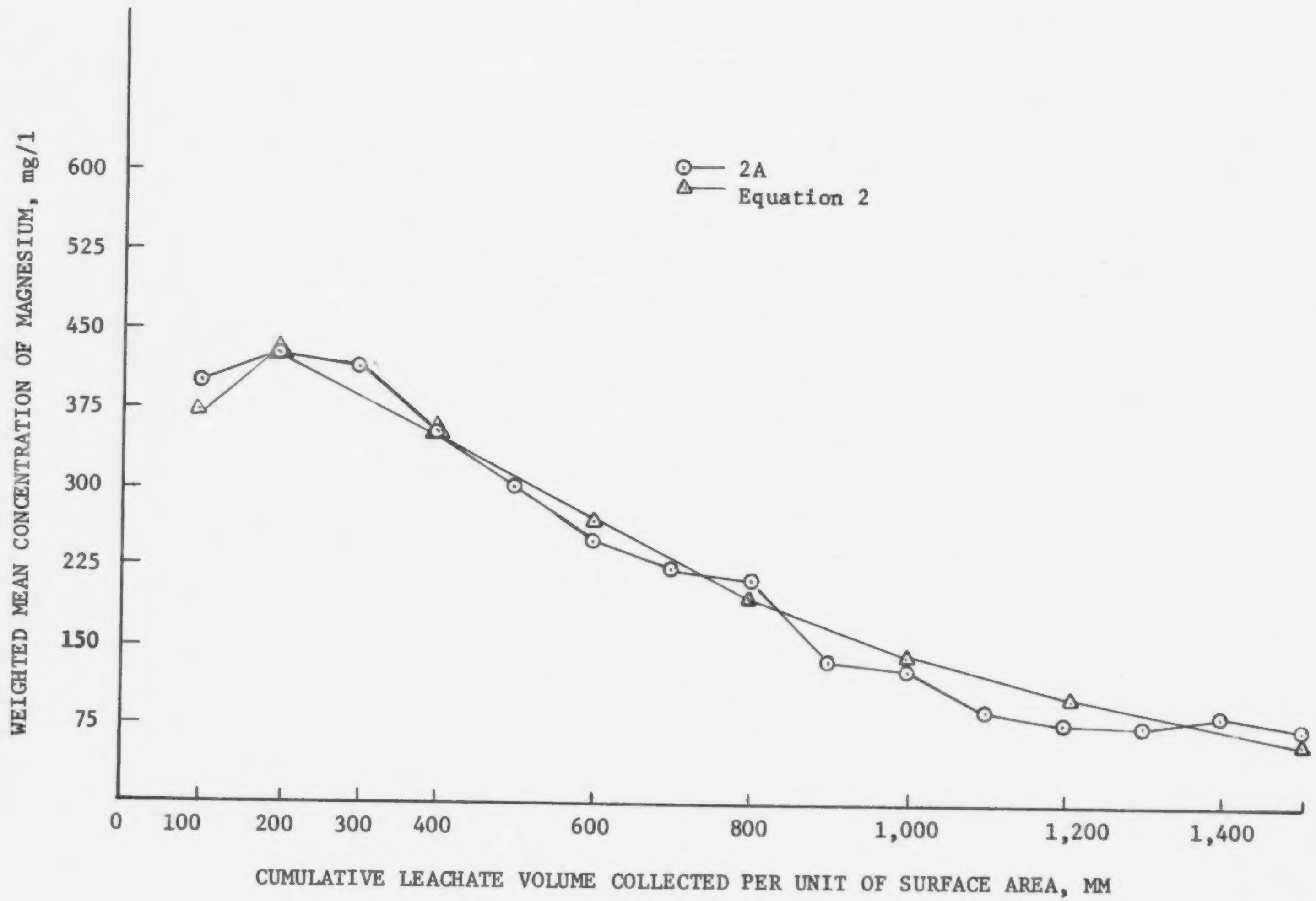


Figure 43. Weighted mean magnesium concentration history: Eqn. 2 - 2A

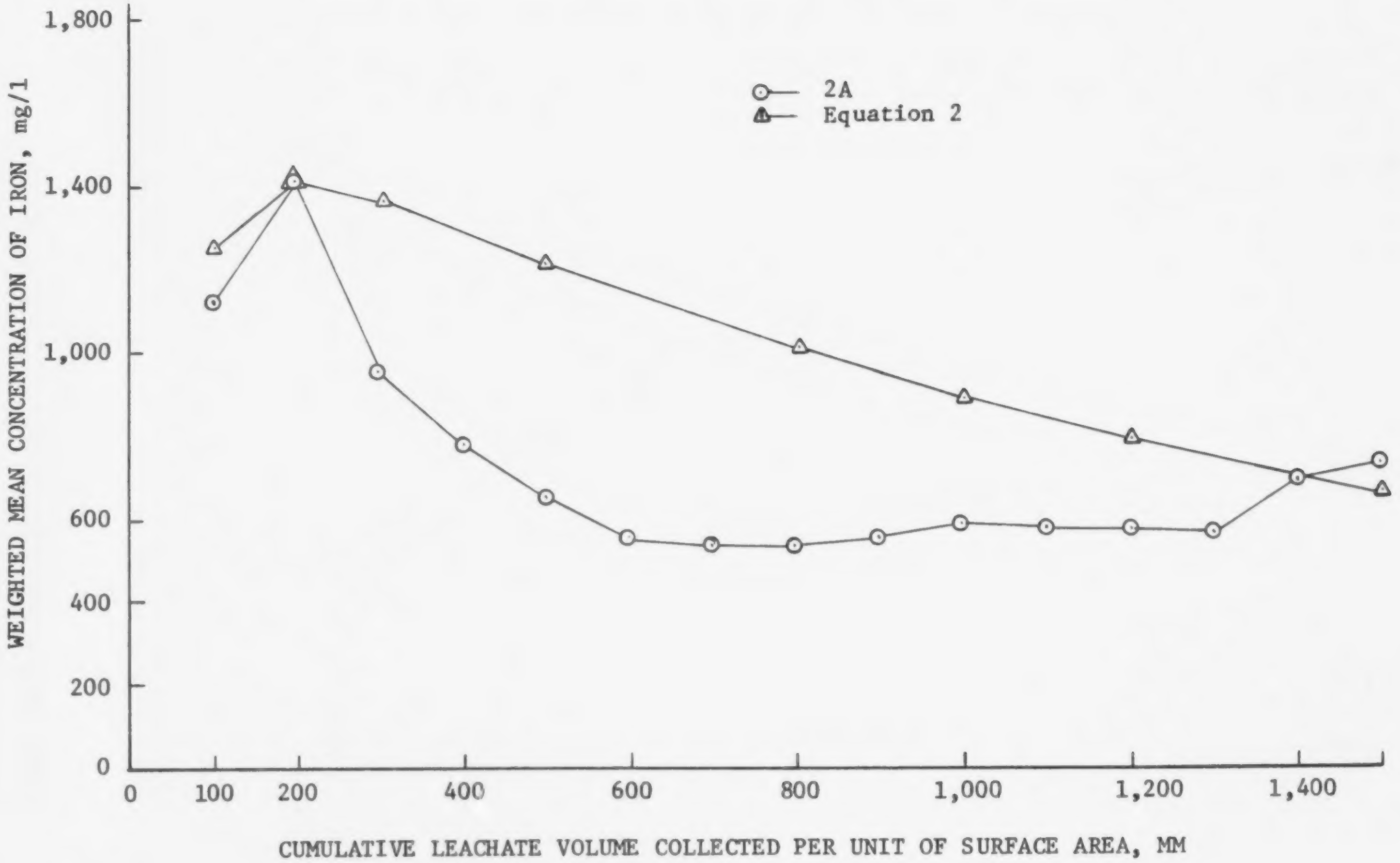


Figure 44. Weighted mean iron concentration history: Eqn. 2 - 2A.

to a lesser extent with COD and sulfate. Curve fitting in these instances was primarily done so that good coincidence was obtained at the end of the data. The total mass available and percentage removal in Table 19 was based on the shape of only 1500 mm of an infinite concentration history so these values should be treated with caution. It is interesting to note, that if this is an accurate representation, the very high removal percentages that had occurred after only 1500 mm of leachate.

The total masses projected in Table 19 for sulfate, chloride and magnesium range from 1/3 to 1/2 of the total amounts measured in the refuse in test cell 1 (5). The projected amount of COD is only 11% of that measured from the samples of refuse in test cell 1. The values in Table 19 might be more accurate projections of the mass that can be removed than that total mass measured in test cell 1 because some of the contaminant mass is probably permanently bound in a non-water soluble state.

It is quite possible that this type of empirical equation with further modifications and verification might be of value. Certainly the accuracy in later leachate flows can only be judged with additional data. It was only compared to cell 2A, which did differ from 2B and 2D and therefore should not be considered a possible descriptor of any refuse leaching situation. A potential is present though, after additional data is accumulated and modifications made, that an equation could be developed that would provide a reasonably accurate prediction of leachate concentrations for landfill and treatment facility design.

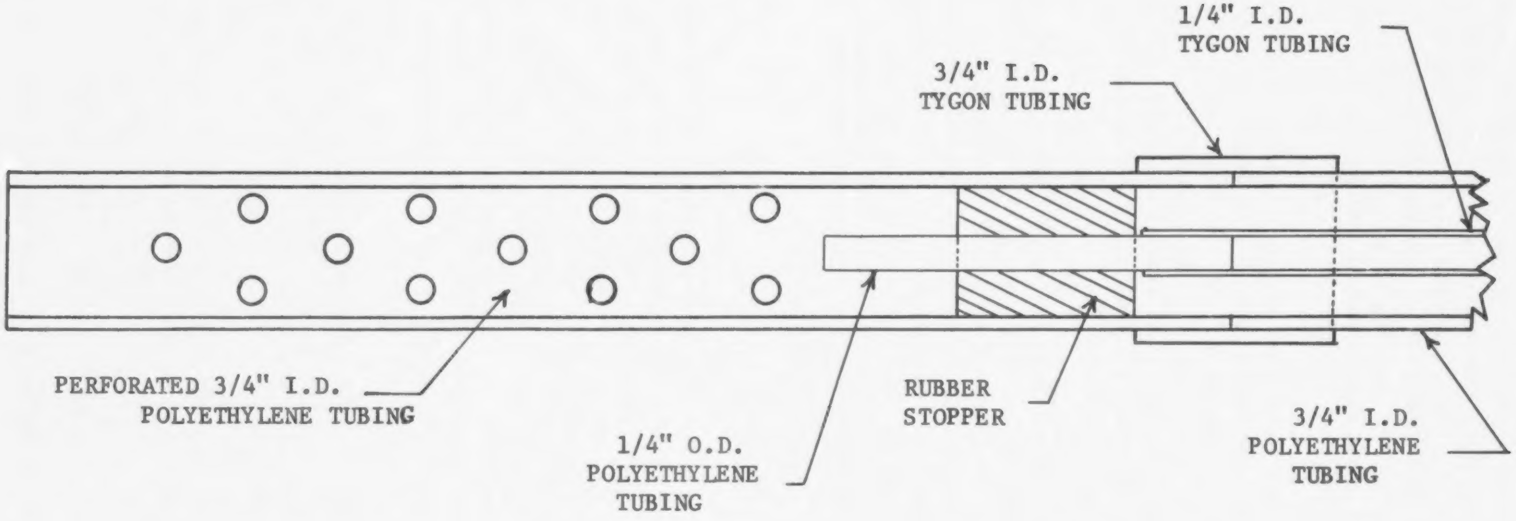
GAS ANALYSIS

Gas samples were obtained from various locations in the cells by use of the tubing apparatus shown in Figure 45. The piping enclosure extended up through the cell cover to a sampling shed. Gas samples were initially obtained by pumping each line through gas sampling tubes for 3 minutes at a flow rate of 33.3 ml/sec prior to removing the tube for analysis. Because residual oxygen was present in most samples, the procedure was modified to provide 5 minutes of pumping. After methane production began in the cells, a thermal conductivity detector was connected to the pump exhaust and samples were obtained only after the detector indicator stabalized. For those probe locations where methane was not present, samples were obtained only after 5 minutes of pumping.

Analyses were run for oxygen, carbon dioxide, methane and nitrogen. Initially samples were taken from 10 probes on a weekly basis for the first two months. The analytical results were quite erratic and much of the data was deleted from the following analysis.

The analyses showed quick depletion of oxygen to less than 4% by volume within 2 weeks after cell completion other than in test cell 2C, level 1. In general, oxygen levels in all probes at levels 4 and 7 were less than 2% after October 1972. Samples showing as great as 5% oxygen in probes at level 1 indicated some gas movement into the cell from the atmosphere.

Samples showed less than 1% methane in all probes until October 1973,



1" = 25.4 mm

Figure 45. Gas collection probe.

when 10.4% was detected in probes 2D1d and 2D4d of cell 2D. Methane concentrations rose to as high as 47.2% in probe 2D1d during September 1976, and to similar levels in 2D4b and 2D4d. After April 1975, methane was detected in amounts greater than 1% in the probes in cells 2A, 2B and 2C. There did not appear to be any greater percent by volume at lower depths within the cells. The highest concentration of methane detected in the small-scale cells was 14.7% during November 1975 at 2C1c.

Carbon dioxide content histories are shown in Figures 46, 47 and 48 for the three sampling levels. No paired difference tests were attempted because of the numerous discontinuities in the data.

The characteristic carbon dioxide bloom occurred in all test cells. The greatest peaks for level 1 occurred in cell 2D. The percent of CO_2 present appeared to increase with greater cell depth. It was not possible to statistically evaluate the similarity of the results for the small-scale cells and 2D. There did appear to be reasonable visual agreement between cells 2A and 2B at level 1 and between 2B and 2C at level 7.

TEMPERATURE

Thermocouples were placed in each of the test cells at the locations indicated in Figures 2, 3 and 5. Probe design is shown in Figure 49. An additional set of probes to determine ambient soil temperatures at depths of .91, 2.13 and 3.05 m were placed in the soil 3.7 m south and .91 m east of the center of cell 2A. The thermocouple wires were protected by polythelene tubing extended through the soil cover to the sampling shed.

Temperatures were recorded every day during August 1972 in order to obtain peak readings. The highest readings obtained were from probes 2A1c and 2B1c on August 18, 1972, 4 and 6 days respectively after refuse placement. Peak temperatures for each probe are shown in Table 20.

After August 1972 temperatures were recorded approximately every week. Some of the probes failed and there were gaps in the data due to recording instrument problems. Paired difference tests were performed for the significance of the average difference on a number of probes. These results are shown in Table 21. Figures 50 through 57 show the mean monthly temperature histories at selected locations.

A comparison of soil and refuse temperatures is shown in Figure 50. A significant statistical difference was obtained for those two probes, Z1 and 2D1c. The primary difference in the two was the greater amplitude of the yearly temperature history in the soil (Z1). There was also an amplitude difference, but of 3-4°F less during seasonal highs than that of 2D1c, for 2A1c, 2B1c and 2C1c when compared to the soil. The time lag between soil and refuse seasonal highs and lows was also more pronounced in the small-scale cells. This amplitude difference and time lag was also noted in test cell 1 and thought to be due to moisture, specific heat and biological activity. Insufficient data from probes Z4 and Z7 did not allow a similar comparison at greater depths.

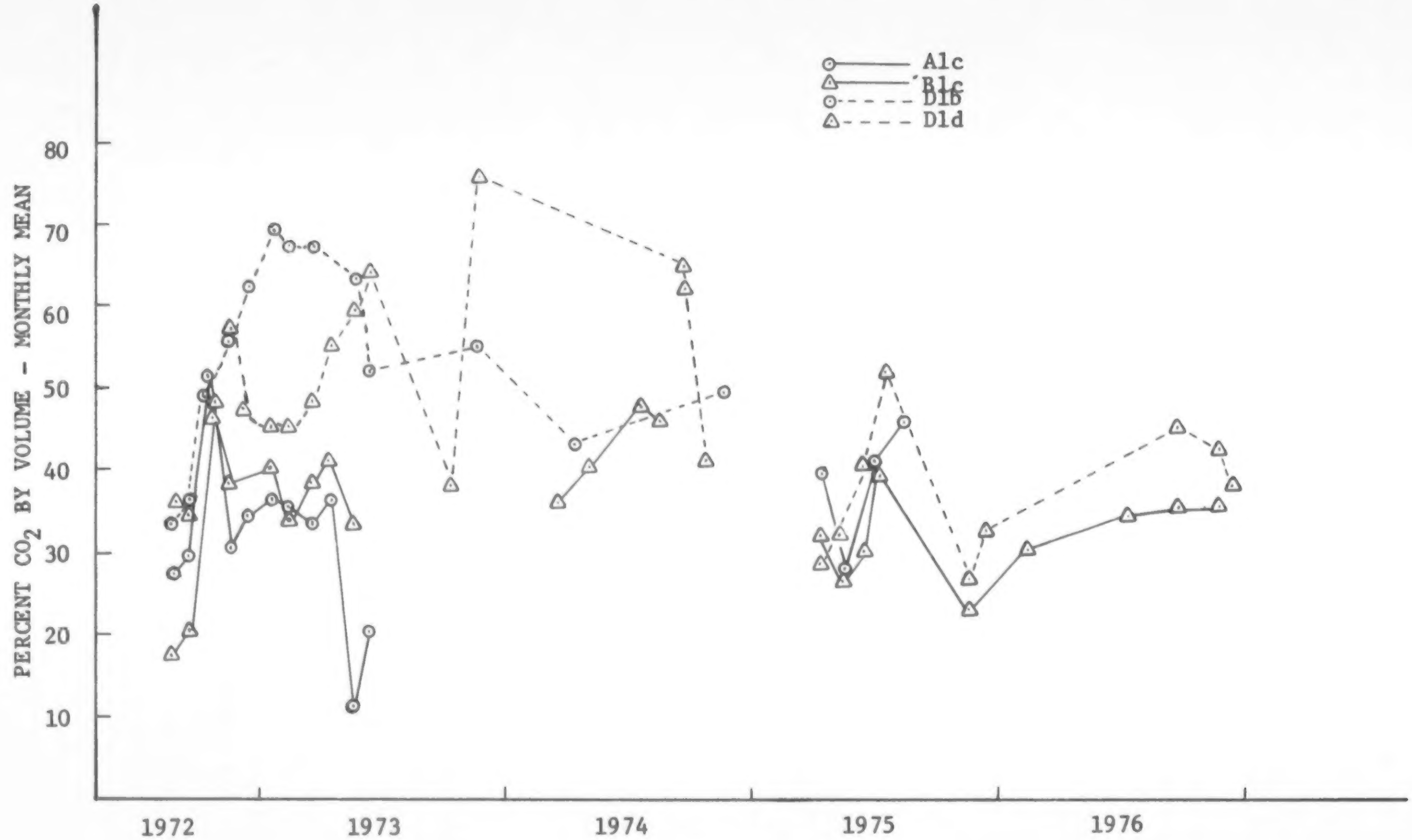


Figure 46. Carbon dioxide content, level 1, test cells 2A, 2B and 2D.

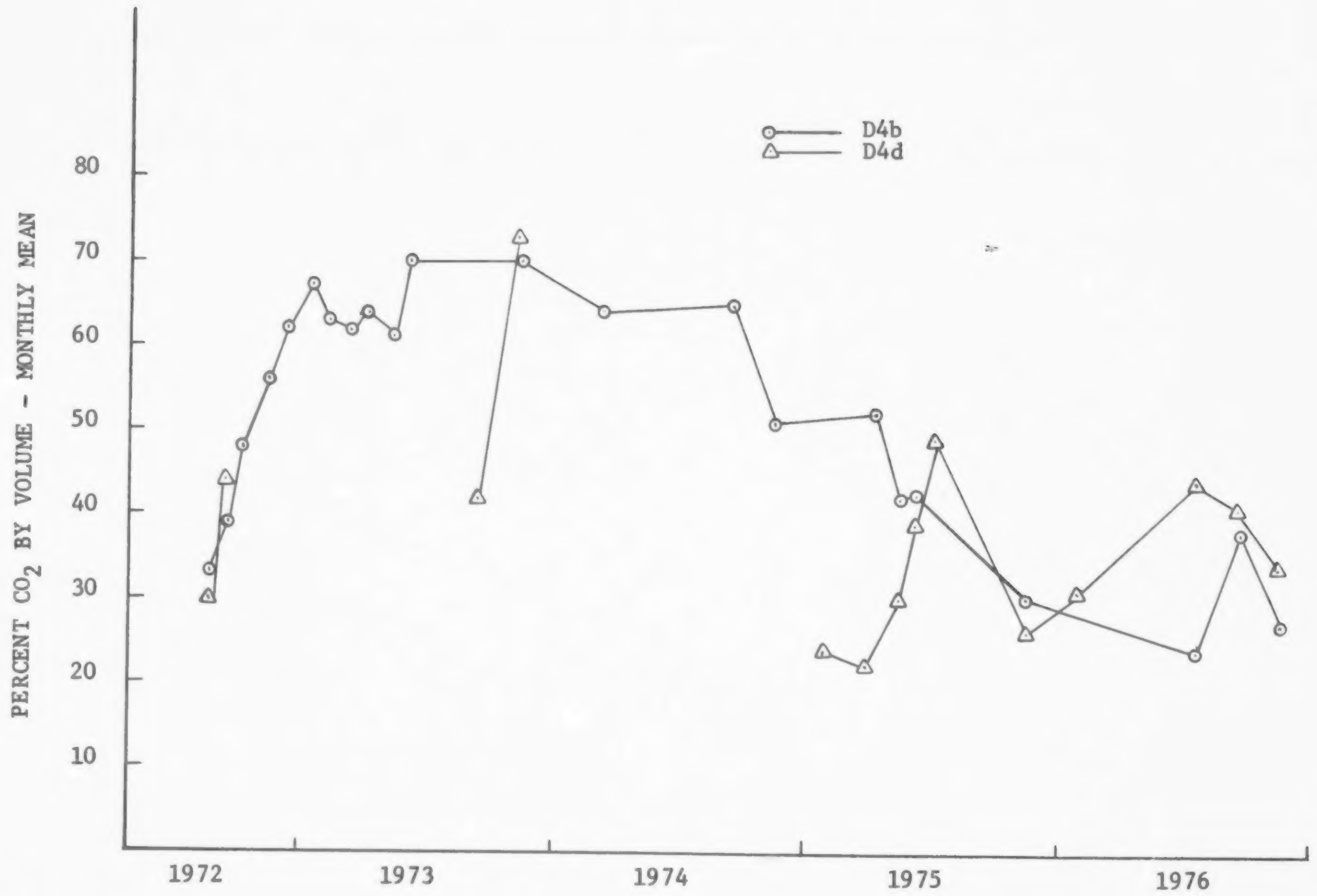


Figure 47. Carbon dioxide content - test cell 2D, level 4.

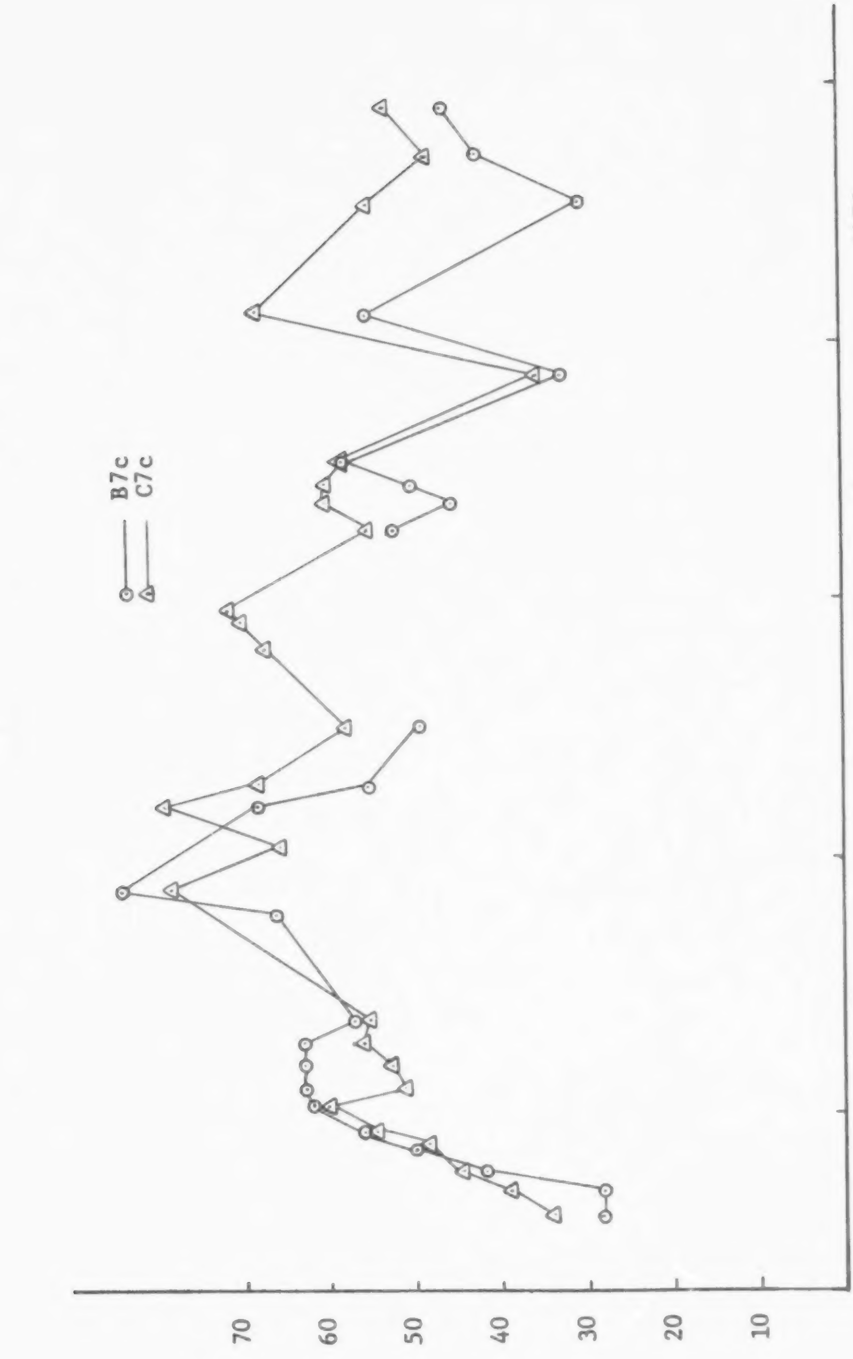
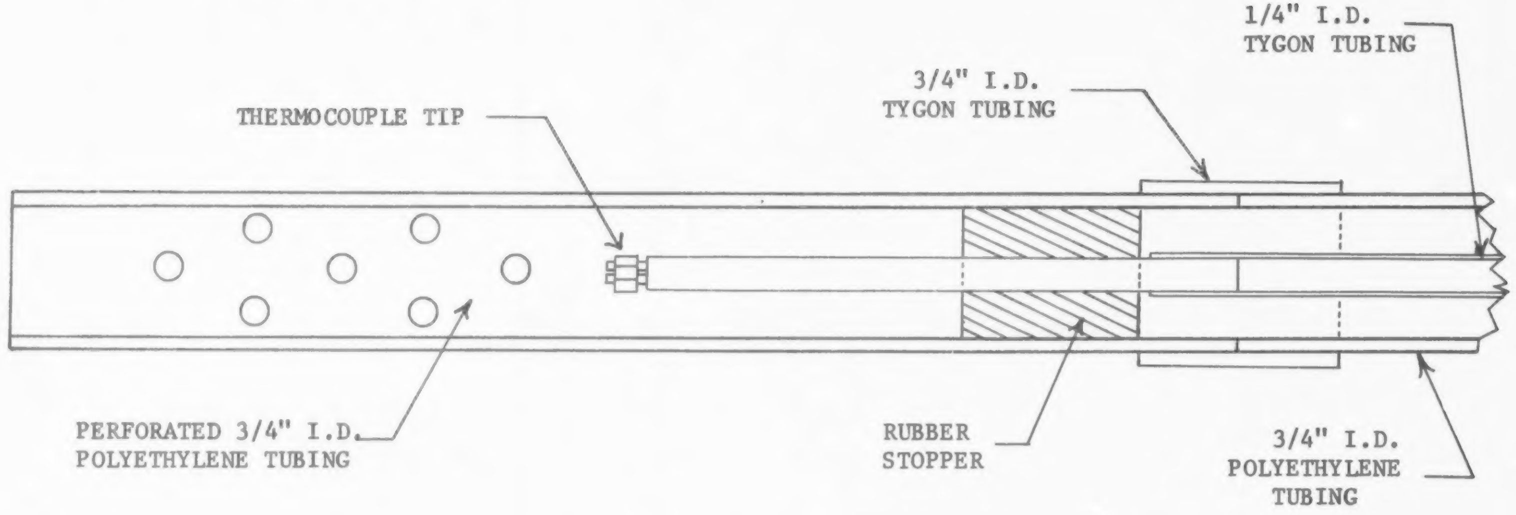


Figure 48. Carbon dioxide content - test cells 2B and 2C - level 7.



1" = 25.4 mm

FIGURE 49. Thermocouple temperature probes.

TABLE 20. PEAK REFUSE TEMPERATURES

Probe	Peak Temperature Recorded[a]	Date
2A1c	124	8-18-72
2B1c	124	8-18-72
2B1e	98	8-17-72
2C1c	99	8-17-72
2D1a	95	8-19-72
2D1b	118	8-19-72
2D1c	122	8-18-72
2D1d	114	8-19-72
2A4c	102	8-15-72
2B4c	98	8-14-72
2B4e	94	8-17-72
2C4c	96	8-16-72
2D4a	101	8-18-72
2D4b	121	8-18-72
2D4c	121	8-17-72
2D4d	119	8-17-72
2A7c	96	8-14-72
2B7c	85	8-14-72
2B7e	75	8-14-72
2C7c	91	8-15-72
2D7a	82	8-17-72
2D7b	113	8-16-72
2D7c	115	8-16-72
2D7d	117	8-16-72

a. degrees Fahrenheit

TABLE 21. PAIRED DIFFERENCE TEST RESULTS - TEMPERATURES

Probes	t_{calc}[a]	t_{10}[b]	Result
2A1c - Z1	1.95	1.69	Significant
2D1c - Z1	12.8	1.70	Significant
2A4c - 2B4c	.069	1.69	Not Significant
2A4c - 2C4c	1.92	1.69	Significant
2A4c - 2D4c	18.3	1.69	Significant
2B4c - 2D4c	21.3	1.69	Significant
2C4c - 2D4c	19.1	1.69	Significant
2B4e - 2B4c	.954	1.69	Not Significant
2D4a - 2D4c	12.0	1.69	Significant

a. t_{calc} - calculated by division of the average difference by the standard deviation of the average difference.

b. t_{10} - tabular t from Reference 6.

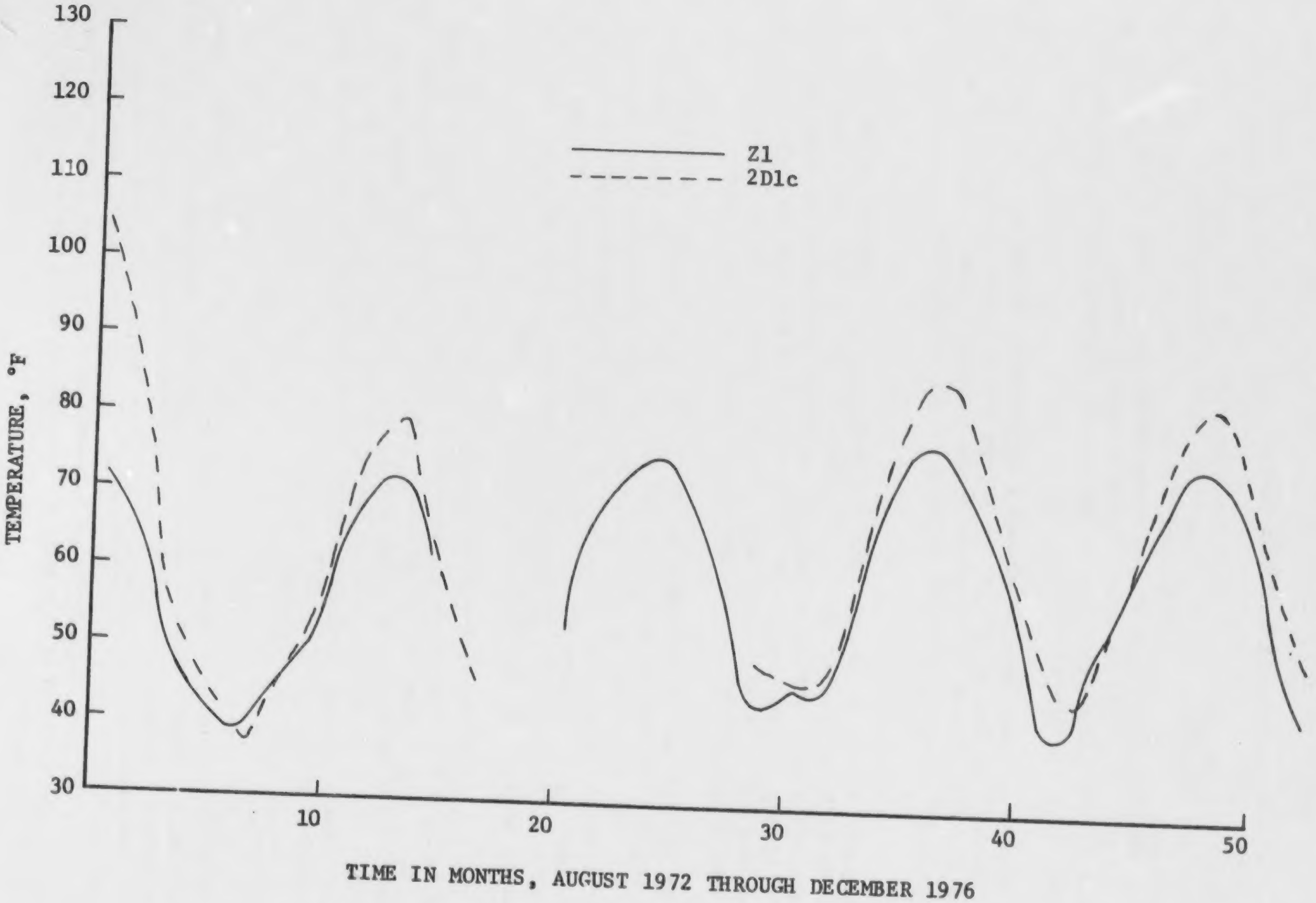


Figure 50. Mean monthly temperatures: Z1 - 2D1c

Annual high temperatures in 2D exceeded those in 2A, 2B and 2C at level 1 (Figure 51). The lows were not substantially different. This difference in peaks indicated greater seasonal aerobic activity in 2D due to greater gas exchange through the soil surface or possibly some heating effect due to the covering. The extent of difference in peaks was not noted at levels 4 and 7. Since similar soils were used for cover, gas diffusion should have been similar. Since the covers used for 2A, 2B and 2C were dome shaped and provided approximately .6 m of air space above the gravel, whereas the polymeric membrane used to cover 2D was placed directly on the gravel, the covers were the suspected cause of the higher temperature difference in the surfical layer of refuse.

Statistical test results showed a significant difference in the temperature histories at the center of the refuse for all small-scale cells when compared to 2D. Figure 52 compares probe 2C4c with 2D4c. The only statistical similarity among the test cells at level 4, location c, was for 2A and 2B.

Figures 53 and 54 demonstrate the reduction in seasonal temperature amplitude with increasing depth. For both 2A and 2D the upper probes showed the greatest yearly amplitude and the earliest attainment of peaks and lows and the lowest probes showed the least amplitude and the greatest time lag to peak and low. Insufficient data from the soil probes at levels 4 and 7 prevented a soil-refuse comparison of amplitude and lag changes.

No statistical significant difference in temperature histories was found between the center and the edge of cell 2B, at locations c and e, level 4. The histories, shown in Figure 55, did differ somewhat though. The statistical similarity results from lower temperatures during the cooler months and higher temperatures during the summer months at the edge of the cell with a resultant low average difference and a small t_{calc}. There was virtually no lateral difference at level 1 in cell 2B.

The extent of the lateral amplitude difference between the edge and the sides in 2B did not occur in 2D at level 4 (Figure 56) or level 1 (Figure 57). There was a time lag to seasonal peak at the center of 2D (probe 2D4c) but no difference in the seasonal peaks. At level 1 in 2D there was no time lag but there were higher seasonal peaks at the center (probe 2D1c). Therefore the same lateral thermal gradient that existed in 2B was either less or nonexistent in 2D.

SETTLEMENT

Settlement readings were taken periodically on all test cells. The cumulative settlement data is shown in Figure 58. Settlement for the small-scale test cells was computed by subtracting the vertical distance from the rim of the pipes to the pea gravel for each reading from the original installed difference in elevation from the rim to the gravel. For the large-scale cell, 2D, the cumulative settlement was the average elevation of 9 points on the surface of the cell subtracted from the average initial elevation of the surface.

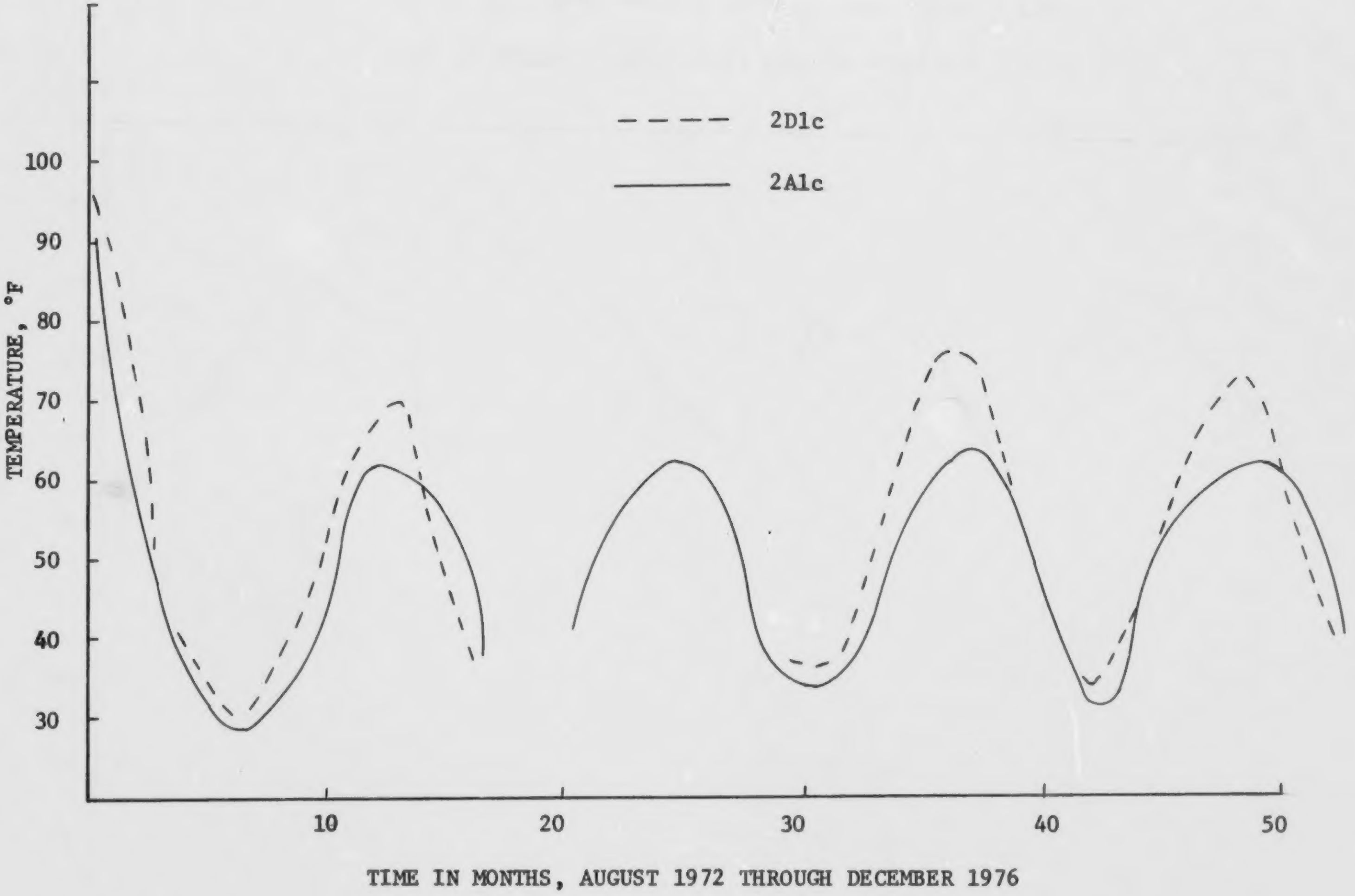


Figure 51. Mean monthly temperatures: 2D1c - 2A1c

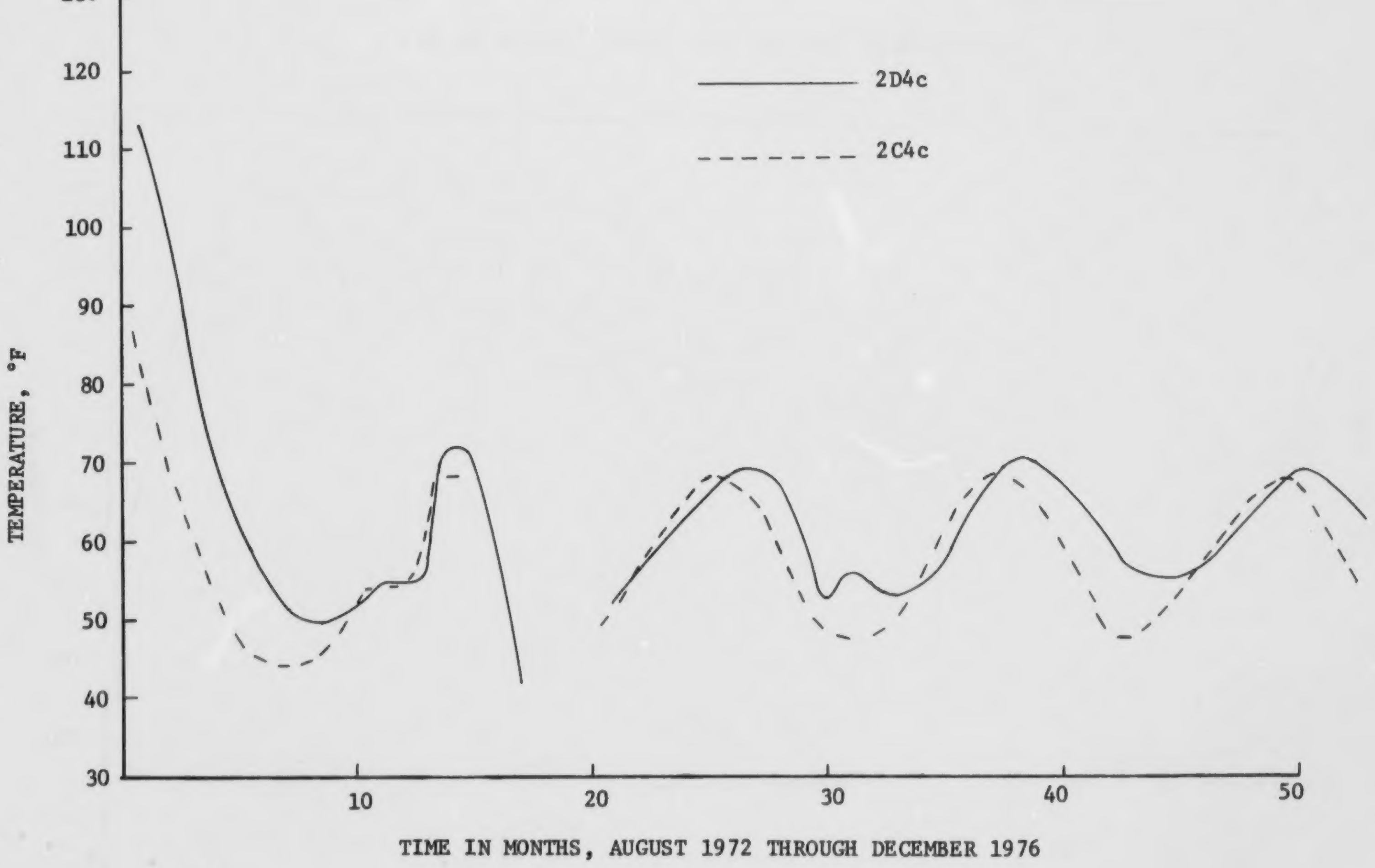


Figure 52. Mean monthly temperatures: 2D4c - 2C4c

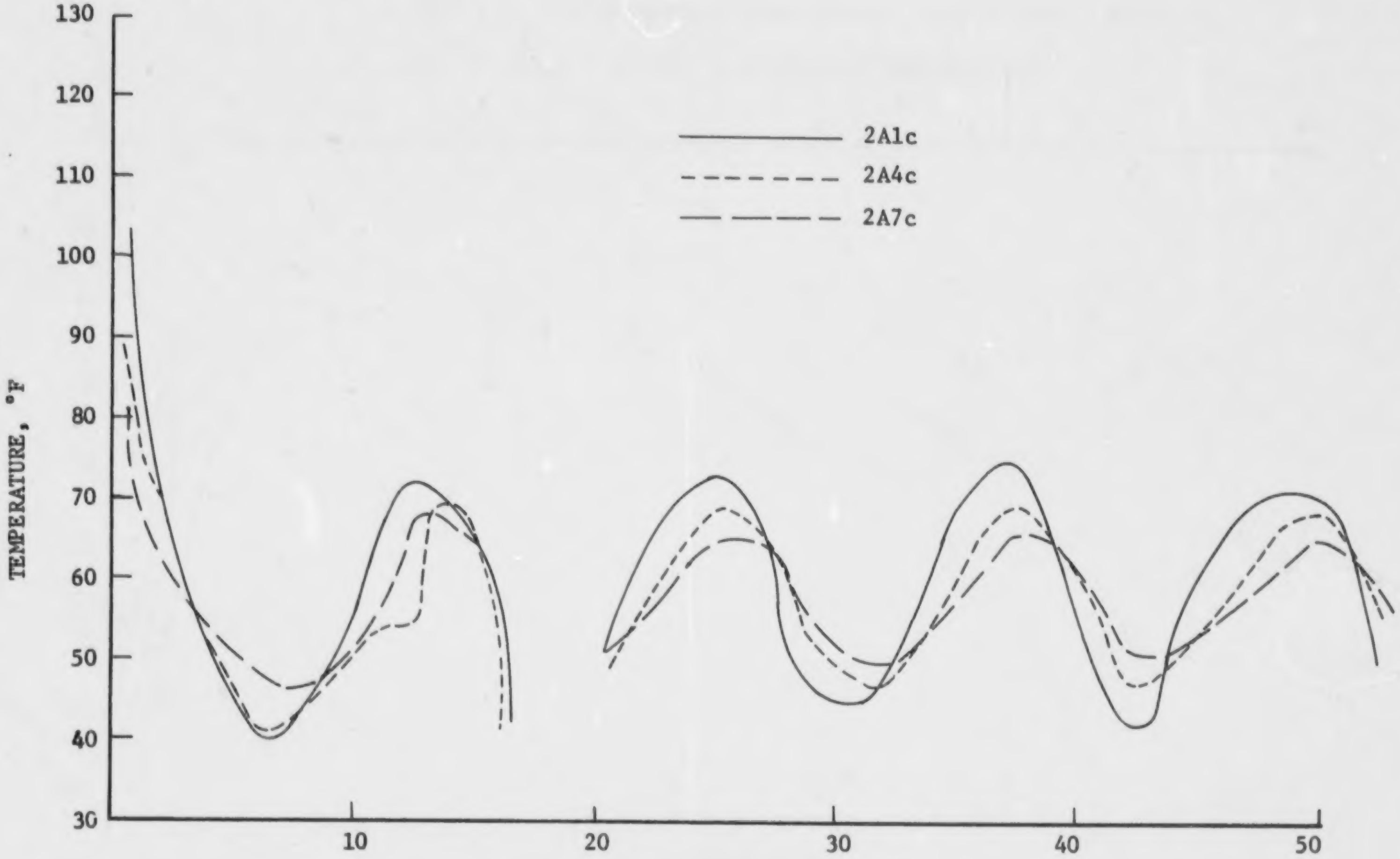


Figure 53. Mean monthly temperature: 2A1c - 2A7c - 2A7c

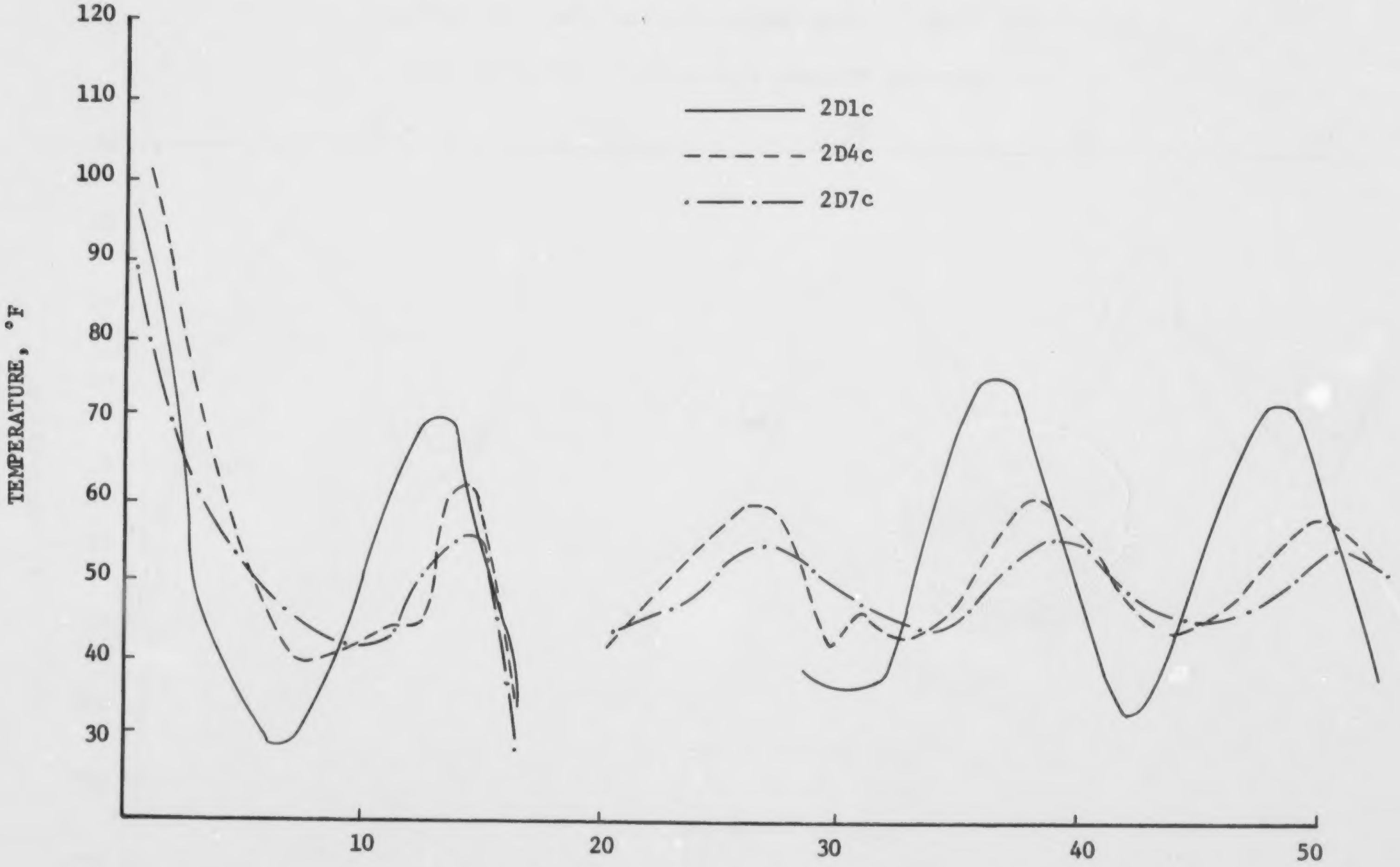


Figure 54. Mean monthly temperatures: 2D1c - 2D4c - 2D7c

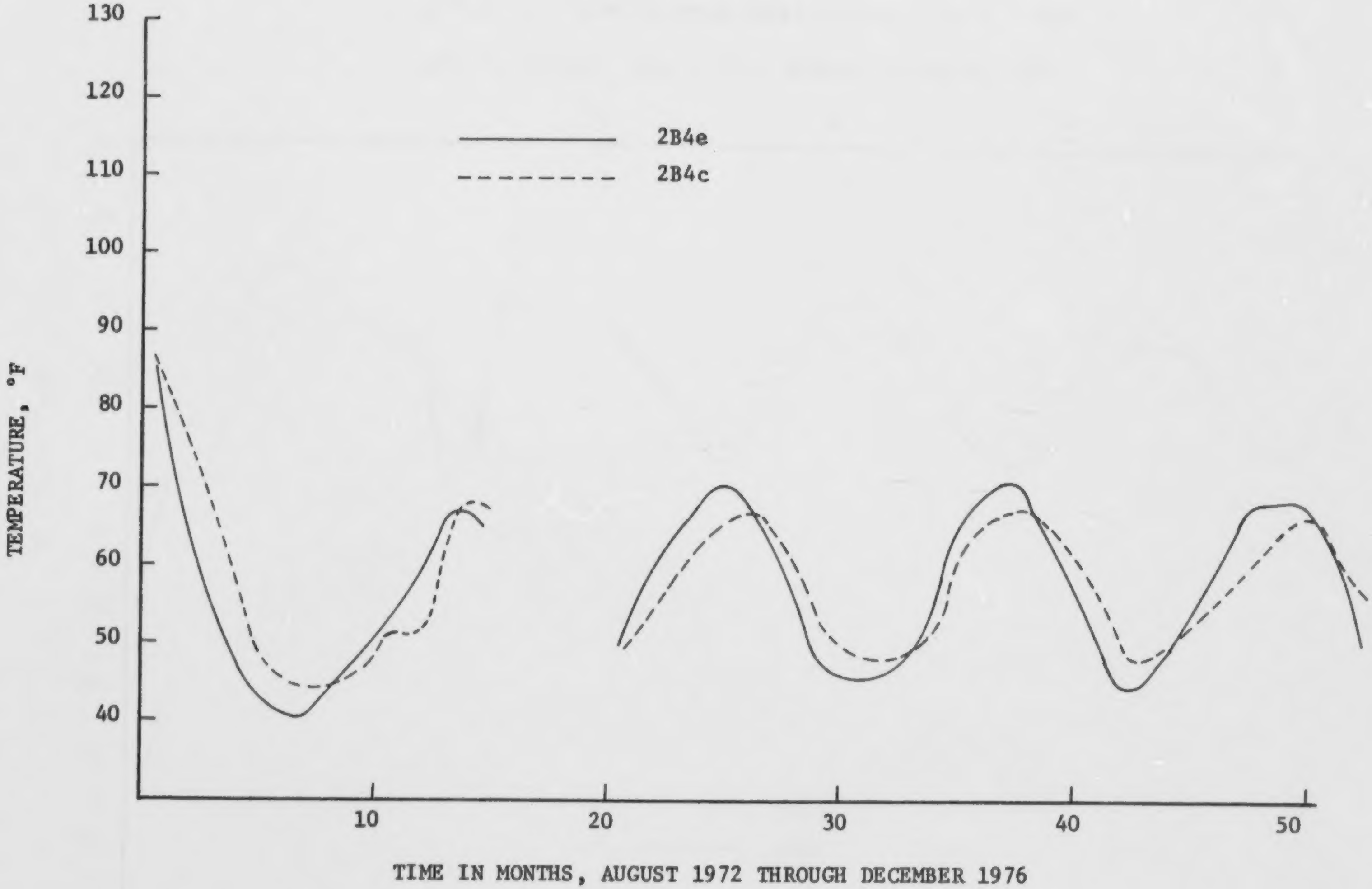


Figure 55. Mean monthly temperatures: 2B4e - 2B4c

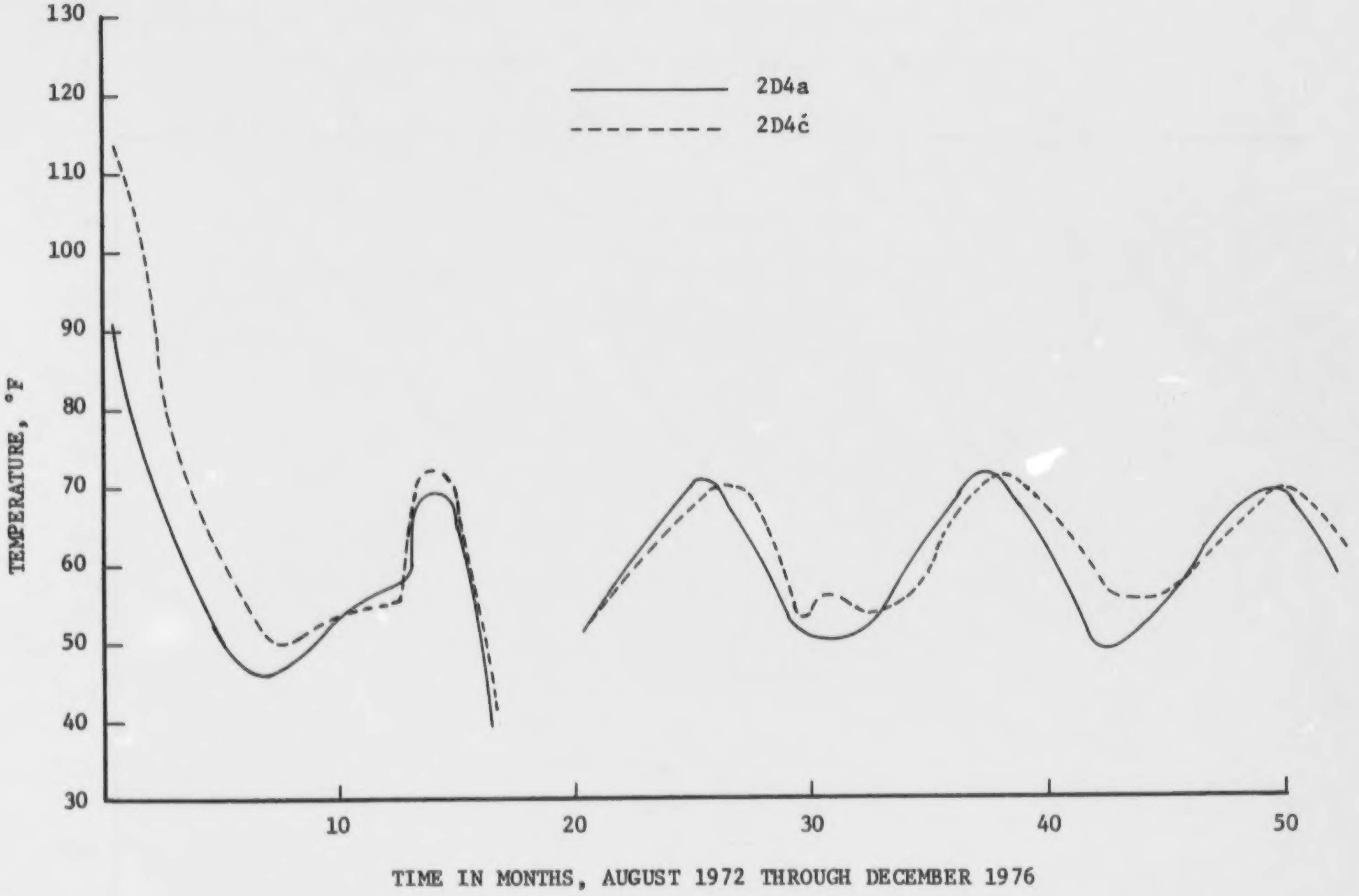
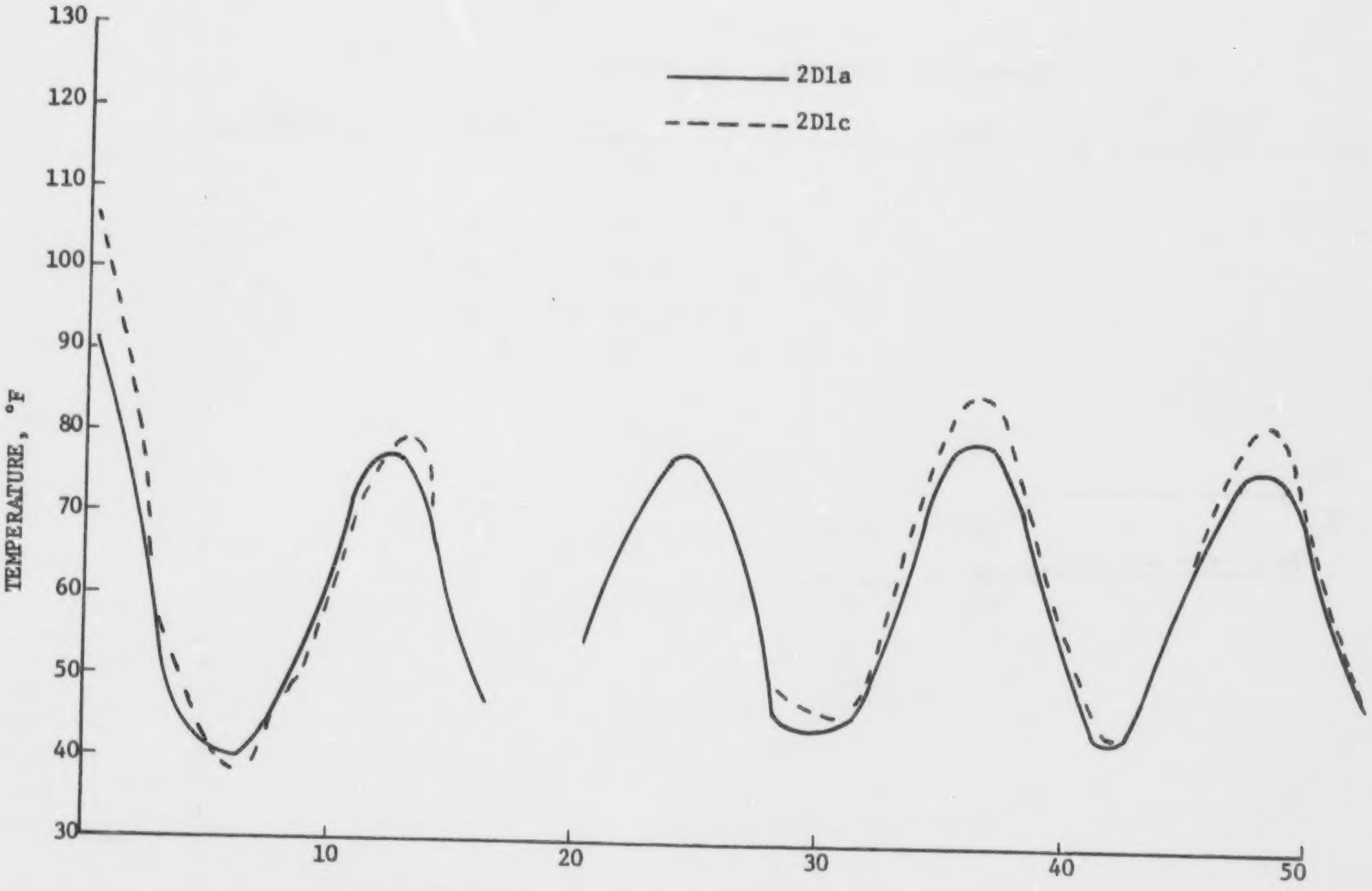


Figure 56. Mean monthly temperatures: 2D4a - 2D4c



TIME IN MONTHS, AUGUST 1972 THROUGH DECEMBER 1976

Figure 57. Mean monthly temperatures: 2D1a - 2D1c

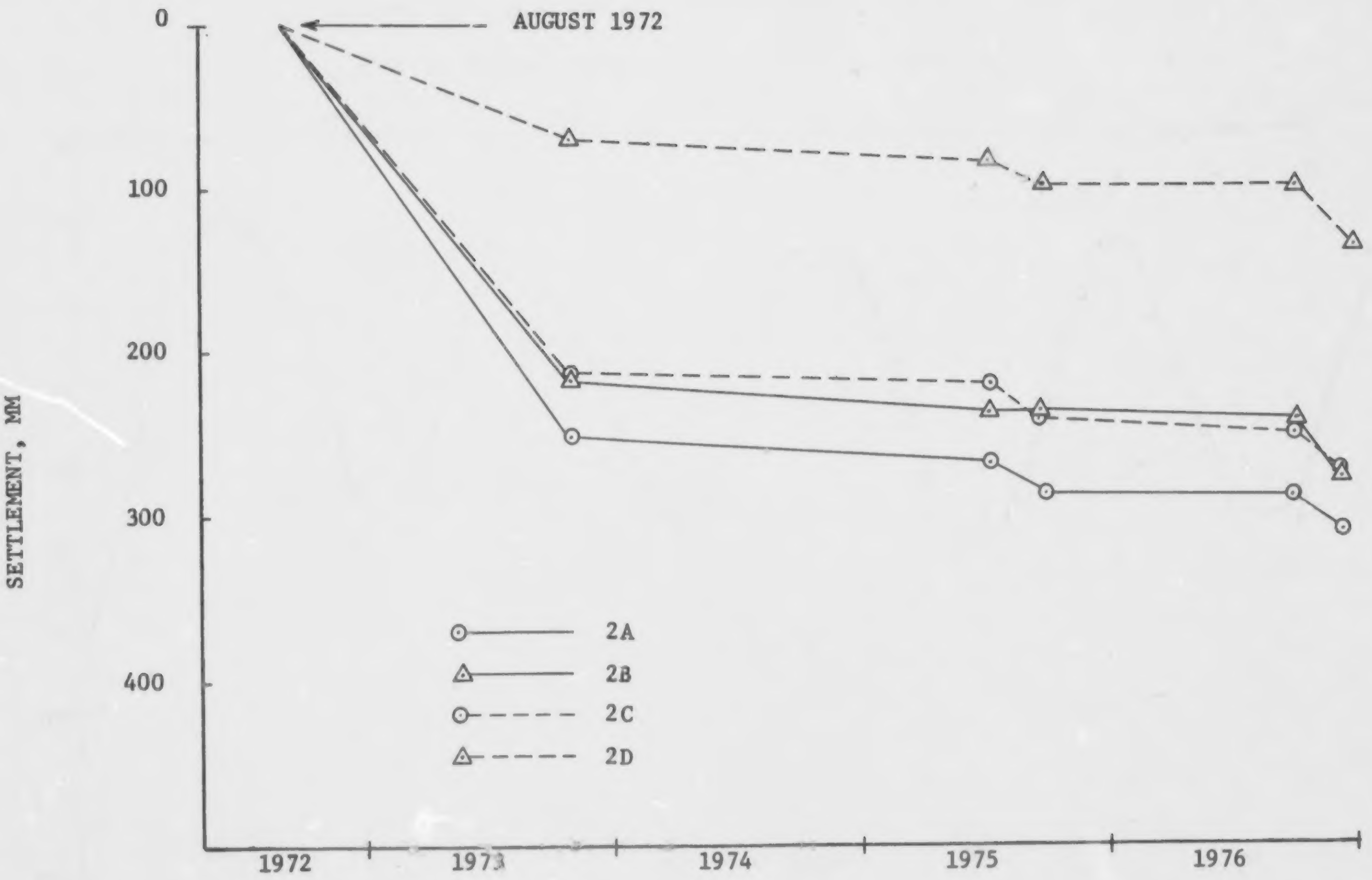


Figure 58. Cumulative settlement.

Settlement in 2A, 2B and 2C was comparable from cell to cell, differing by less than 12%. Cumulative settlement after 52 months averaged 11% of the total depth for the 3 cells. There did appear to be some correlation with initial refuse density as 2A, the least dense, recorded the greatest settlement.

Cumulative average settlement for 2D was 137 mm, 5.6% of total depth, only half that experienced in the small-scale cells. There was a 45% higher initial wet density in 2D. Settlement in test cell 1 was 4% of total depth after the same time period. The cumulative settlement was relatively uniform on the surface of 2D, varying from 85-158 mm over the 9 measurement points.

SUMMARY OF COMPARISON OF PERFORMANCE OF TEST CELLS

As stated earlier, one of the primary objectives of the research was to evaluate the behavior of a field-scale test cell, 2D, as compared to similarly constructed small-scale cells. It was desired to determine whether scaling factors were involved and if the small cells produced duplicate results so that future research efforts might utilize small, less expensive cells, for prediction of field behavior.

The experimental design was to have similar initial refuse composition, moisture, and density in all cells and to control water input to approximately 500 mm per year. Composition and initial moisture content were found to be statistically similar and refuse depths only varied 5%. The in-place refuse density in 2D though was 45% greater than the average refuse density in the small cells on a wet weight basis.

Water input, infiltration, and evaporation were controlled by periodically covering the cells and with a layer of pea gravel over the soil cover. Leachate collected (Figures 5 and 6) from one of the small cells, 2C, was so substantially different from 2A and 2B that the leachate data was not used in any comparative analysis. Leachate production from 2D was much larger than from the remaining small-scale cells, 2A and 2B, and was in excess of precipitation. By the end of 1976, 72% more leachate per unit of collection surface area had been produced in 2D than 2B and 50% more than from 2A. This excess leachate production, peak concentrations lower than those experienced in 2A and 2B, and depressed mass removals with cumulative flow, indicated the possibility of significant diluting leakage into 2D from the sides and possible channelling through the cell.

This large difference in leachate production from 2D was considered sufficient enough so as to preclude the possible comparability of cell performance between the large and small-scale test cells. It would be unbounded to assume without further work that the observed behavior would have been the same had water input been constant.

Leachate concentration data was analyzed by comparing data points occurring at equal volumes of leachate. This normalizing may not have been sufficient to correct for the variation in water input, particularly if it was due to diluting leakage. Statistical comparison results might also have been biased by utilizing weighted mean concentrations rather than actual data.

The paired difference test used did not appear to be adequate for comparing concentration histories of the different cells, but was adequate for comparing incremental mass removals.

For only 4 of 14 parameters studied was the average difference of the concentration history curves of 2A and 2B statistically similar. Examination of the figures though showed similar responses and data trends for all but 1-2 of the parameters. A greater number than 4 of 14 of the parameter concentration histories of 2A or 2B or the average of 2A and 2B were found to be statistically similar to 2D. This would not be expected given the wide variation in leachate production, and examination of the figures indicated a much greater deviation in performance in comparing 2D to the small-scale cells than had occurred between 2A and 2B. Comparison of incremental mass removals from 2A and 2B showed 9 of 14 parameters to be statistically similar, indicating closely parallel histories.

It was not possible to statistically compare gas composition data due to discontinuities and erratic results. There did appear to be reasonable visual agreement for CO_2 between cells 2A and 2B at level 1 and between 2B and 2C at level 7. Methane levels were generally higher in 2D.

Statistical comparison of temperature histories showed significant differences for most of the probes. At the center of the refuse the small-scale cells were more nearly similar than any of the histories of the small-scale cells compared to 2D. Higher temperatures were recorded at seasonal peaks in the surficial layer of refuse in 2D than in 2A, 2B, and 2C. This was felt to be due to the difference in the covers. The inadequacy of the statistical test was demonstrated in comparing the lateral amplitude difference of the temperature histories. While for 2B no statistical difference was found at level 4 between the center and the edge of the cell, the thermal gradient in 2B was greater than that in 2D where a statistical difference was indicated.

Settlement in 2A, 2B and 2C was comparable from cell to cell, differing by less than 12%. Some correlation between initial density appeared to exist. Cumulative average settlement for 2D was only half that experienced in the small scale cells, probably as a result of the 45% greater initial density.

In summary, density and leachate volume production differences did not allow accurate definitive comparison of small and large-scale test cells. While concentration data trends among the two small-scale cells were relatively close, the statistical evaluation of comparative behavior of the identically constructed small-scale cells was inconclusive. Further work with the data from 2D and the use of a more applicable statistical measure of similarity might produce more conclusive results of comparability or define any scaling factors. This further work together with analysis of data from similar studies might also indicate that landfill leachate behavior monitoring results can be expected to show performance variations inherent in the complex refuse-landfill system.

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APPENDICES

APPENDIX A

SUMMARY OF CELL DATA

	Test Cell			
Parameter	2A	2B	2C	2D
Date start of test	8-14-72	8-11-72	8-15-72	8-18-72
Date of first leachate	6-5-73	2-27-73	6-19-73	9-25-72
USCS soil classification	CL	CL	CL	CL
Surface area of soil cover, m^2	2.627	2.627	2.627	72.83
Depth of soil cover, m	.30	.30	.30	.30
Wet density of soil cover, kg/m^3	1757	1679	1706	1842
Moisture content of soil cover, % wet weight	15.8[a]	15.8	15.8	15.8
Surface area of refuse, m^2	2.627	2.627	2.627	72.83
Depth of refuse, m	2.56	2.56	2.56	2.44
Mass of refuse, kg (wet)	2640	2898	2814	106,231
Wet density of refuse, kg/m^3	392.6	430.9	418.4	597.8
Moisture content of refuse, % wet weight	22.5	27.1	24.1	31.8

[a] Not measured, assumed to be the same as for test cell 1.

APPENDIX B

PRECIPITATION AND LEACHATE QUANTITIES

		Leachate Collected[b]			
Date	Precipitation[a]	2A[c]	2B[c]	2C[c]	2D[d]
8-30-72	29.72				
9-7	7.11				
9-14	14.22				
9-25	--				66.3
9-28	119.38				
10-2	--				51.0
10-5	47.24				
10-10	--				41.5
10-12	7.62				
10-19	3.00				
10-24	--				33.5
10-25	--				1.0
10-26	3.30				
11-2	64.30				
11-7	--				118.8
11-9	31.20				
11-16	45.20				
11-20	--				252.0
11-24	21.10				
11-30	23.11				
12-4	--				272.0
12-5	--				88.0
12-7	17.02				
12-13	--				3.7
12-14	61.21				
12-18	--				901.1
12-19	--				448.0
12-21	18.03				
12-28	12.95				
1-2-73	--				950.0
1-9	14.73				
1-16	--				1194.8
1-17	--				364.0
1-19	--				234.4
1-22	--				207.9
1-23	14.99				132.3
1-26	--				162.5
1-30	14.22				143.6
2-6	11.18				
2-12	--				359.6

a. mm
b. liters
c. 1 liter = .381 mm
d. 1 liter = .01375 mm

PRECIPITATION AND LEACHATE QUANTITIES

		Leachate Collected[b]			
Date	Precipitation[a]	2A[c]	2B[c]	2C[c]	2D[d]
2-13-73	6.86		1.2		227.1
2-20	21.59				
2-27	--		30.2		757.1
3-1	Cells Covered				
3-13			15.1		794.9
3-15			0.3		0.3
3-27			15.1		1404.4
4-10			11.7		1419.5
4-24			10.2		1343.8
5-8	Cells Uncovered				
5-14	12.19				
5-21	10.16				
5-22	--				966.3
5-29	55.37				
6-5	37.08	45.4	45.4		1892.7
6-11	19.56				
6-17	--	86.9			
6-18	21.34				
6-19	--		60.5	11.3	2082.0
6-25	31.24				
6-26	Cells Covered				
7-3		152.0	140.0	23.8	4974.0
7-17		18.9	26.0	22.7	2487.0
7-31		45.4	26.5	18.9	2244.8
8-14		105.8	30.2	18.9	1343.8
8-28		113.4	26.5	15.1	1173.5
9-11		94.5	22.7	11.3	1135.6
9-19	Cells Uncovered				
9-24	18.54				567.8
9-25	--	94.5	22.7	11.3	454.3
10-1	57.15				
10-2	13.97				
10-2	Cells Covered				
10-8					1022.1
10-9		94.5	37.8	18.9	889.6
10-23		83.2	37.8	18.1	927.4
11-7		86.9	34.0	7.6	1059.9
11-20		41.6	28.4	4.5	851.7
11-27	Cells Uncovered				
12-3	20.57				
12-4	--	79.4	26.5	0.9	1230.3

a. mm
c. 1 liter = .381 mm
b. liters
d. 1 liter = .01375 mm

PRECIPITATION AND LEACHATE QUANTITIES

Date	Precipitation[a]	Leachate Collected[b]			
		2A[c]	2B[c]	2C[c]	2D[d]
12-11-73	7.62				
12-13	--				3.8
12-17	8.64				
12-18	--	68.0			757.1
12-26	33.78				
1-2-74	23.88				
1-7	14.22				
1-14	34.54				
1-15	--	128.5	90.7	22.7	3444.7
1-18	Cells Covered				
1-29		88.8	73.0	8.7	3009.4
2-12		68.0	52.9	1.9	1798.1
2-26		58.0	37.8	1.5	1048.6
3-12		48.0	32.1	4.2	1135.6
3-15	Cells Uncovered				
3-18	22.35				
3-26	--	42.7	27.6	4.5	1866.2
4-1	21.34				
4-2	18.80				
4-4	25.91				
4-8	31.75				
4-8	Cells Covered				
4-9		60.5	68.0	15.9	1533.1
4-11					2271.3
4-23		87.9	75.6	6.1	2460.5
5-7		80.2	75.6	3.8	1817.0
5-21		49.1	45.4	1.5	2150.1
6-3	Cells Uncovered				
6-5	--	22.7	30.2	2.7	1154.6
6-10	24.13				
6-17	6.35				
6-18	--	22.7	26.0	3.0	1014.5
6-24	81.53				
7-1	7.11				
7-1	Cells Covered				
7-2		107.8	91.0	11.0	2332.2
7-16		84.5	80.1	11.0	2359.1
7-30		36.3	37.0	8.7	1419.5
8-6					151.4
8-13		28.4	31.0	9.5	1385.5
8-27		26.5	24.6	8.3	991.8

a. mm
b. liters
c. 1 liter = .381 mm
d. 1 liter = .01375 mm

PRECIPITATION AND LEACHATE QUANTITIES

		Leachate Collected[b]			
Date	Precipitation[a]	2A[c]	2B[c]	2C[c]	2D[d]
9-10-74		22.7	26.5	18.9	2203.1
9-24		24.0	22.0	1.5	1589.9
10-8		17.5	20.2	1.5	662.5
10-22		16.0	18.0	1.2	1135.6
10-31	Cells Uncovered				
11-5	--	13.5	17.0	1.1	908.5
11-7	21.34				
11-14	19.30				
11-19	--	12.5	14.5	0.8	776.0
11-21	18.03				
11-29	13.46				
11-29	Cells Covered				
12-3		12.6	15.0	1.1	1022.1
12-17		12.9	17.1	1.5	2744.4
1-14-75		16.0	21.0	1.1	2271.3
1-16					1154.6
1-28		12.5	17.5	1.1	1703.4
2-3					1029.6
2-11		10.1	14.1	1.5	1533.1
2-20	Cells Uncovered				
2-25	--	20.9	19.5	15.9	4220.7
2-27	85.09				
3-5	--				700.3
3-7	8.38				
3-11	--	34.3	34.0	1.1	378.5
3-13	36.32				1926.8
3-20	35.81				
3-24	52.07				
3-24	Cells Covered				
3-25		132.0	151.2	7.9	2271.3
3-27					2468.1
4-1					189.3
4-8		88.0	109.7	2.3	1549.8
4-10					2305.8
4-22		56.0	80.0	2.6	2570.4
5-6		37.8	37.8	3.9	2736.0
5-20	Cells Uncovered				
5-29	3.05				
6-3	--	30.3	26.5	6.8	1790.3
6-5	62.23				
6-12	71.63				

a. mm
b. liters
c. 1 liter = .381 mm
d. 1 liter = .01375 mm

PRECIPITATION AND LEACHATE QUANTITIES

Date	Precipitation[a]	Leachate Collected[b] 2A[c]	 2B[c]	 2C[c]	 2D[d]
6-17-75	--	114.0	144.4	15.2	4449.1
6-19	65.53				
6-19	Cells Covered				
7-1		128.5	155.0	11.3	3810.2
7-15		98.3	76.0	1.8	2657.3
7-29		60.5		1.8	971.5
8-12		53.2	41.8	1.8	1368.4
8-26		34.2	31.5	1.8	786.2
9-9		31.0	27.0	2.3	808.9
9-23		21.0	22.0	3.0	1126.4
10-7		18.0	17.3	0.8	385.6
10-21		15.2	15.2	3.0	1092.4
11-4		12.8	12.8	2.3	1504.4
11-6	Cells Uncovered				
11-13	26.16				
11-18	--	13.5	11.3	1.8	506.5
11-28	21.08				
12-2	--	10.9	12.2	1.4	529.2
12-4	17.53				
12-8	--				415.8
12-11	16.26				
12-15	21.59				
12-15	Cells Covered				
12-16		14.0	16.5	4.6	600.4
1-20-76		29.0	27.5	2.0	1542.8
2-3		22.5	24.6	1.6	2055.8
2-17		18.5	20.1	1.6	1789.8
3-2		14.3	18.2	5.2	2543.9
3-16		12.8	19.3	2.8	1767.0
3-30		12.0	14.6	2.1	1162.8
4-6	Cells Uncovered				
4-13	3.05	10.7	14.4	2.0	1035.7
4-20	5.08 (2B only)				
4-27	16.26	9.7	12.1	2.7	757.0
5-4	7.62				
5-11	4.32	9.4	12.1	1.5	873.2
5-18	36.07				
5-25	0.00	10.1	13.6	4.5	759.8
6-1	62.48				
6-3	1.52				
6 3	Cells Covered				

a. mm

b. liters

c. 1 liter = .381 mm

d. 1 liter = .01375 mm

PRECIPITATION AND LEACHATE QUANTITIES

Date	Precipitation[a]	Leachate Collected[b] 2A[c]	2B[c]	2C[c]	2D[d]
6-8-76		38.1	36.2	5.3	1113.4
6-22		38.0	40.0	3.2	1958.0
7-6		30.0	30.0	2.5	1717.6
7-20		28.0	30.0	2.5	1599.8
8-3		21.0	24.5	1.5	855.0
8-17 Cells Uncovered					
8-27	0.00				76.0
8-31	9.40	16.0	19.0	3.2	585.2
9-7	7.11				
9-14	17.02	14.5	18.2	2.8	741.0
9-21	4.32				
9-28	56.13	17.0	21.0	11.0	1353.2
10-5	5.33				
10-12	16.51	37.5	41.5	4.2	1504.8
10-19	0.00				
10-26	48.77	52.3	62.5	13.5	1439.2
11-2	22.35				
11-9	--	60.0	66.0	4.1	2029.2
11-23	0.00	47.5	51.3	4.1	2300.9
11-30	16.26				
12-7	6.60	39.6	37.4	2.6	780.9
12-14	3.81				
12-20	3.81				
12-21	--	21.5	27.5	3.6	
12-27	1.78				
1-3-77	1.52				
1-4	--	19.0	25.5	3.2	570.8

a. mm
b. liters

c. 1 liter = .381 mm
d. 1 liter = .01375

APPENDIX C

In Appendix C is presented most of the results of leachate sample analyses. Additional analyses were made on occasions for a number of trace metals; dissolved, total, suspended, volatile and fixed solids; total organic carbon; threshold odor; cyanide; flouride; phenols; and organic acids.

Weighted mean concentrations for 100 mm intervals were computed from this data by calculating the mass of the parameter collected, from sample to sample, based on the volume of leachate collected between samples, multiplied by the most recent sample concentration. The sum of these masses for each sample date divided by the total quantity of flow (approximately 100 mm) gave the weighted mean concentration for the 100 mm interval.

All results are reported as mg/l except pH (standard units) and conductivity (μmho/cm @ 25°C). Phosphate results are expressed as PO_4 and BOD is based on 5-day oxygen use. The following notations are used in the tabulation:

N.V. - result not valid.
N.A. - not analyzed.
N.D. - not detected.

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	9/25/72	10/02/72	10/10/72	10/24/72	11/07/72	11/20/72
pH							
	2A						
	2B						
	2C						
	2D	5.4	6.2	6.1	6.2	6.1	6.0
CONDUCTIVITY							
	2A						
	2B						
	2C						
	2D	3600	5000	5000	3600	5600	5200
ALKALINITY ($CaCO_3$)							
	2A						
	2B						
	2C						
	2D	430	1394	1646	2010	1920	2041
ACIDITY ($CaCO_3$)							
	2A						
	2B						
	2C						
	2D	646	649	1072	1344	1616	1611
HARDNESS							
	2A						
	2B						
	2C						
	2D	1356	842	3007	2962	1007	1195
CALCIUM							
	2A						
	2B						
	2C						
	2D	223	232	349	341	311	308

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	12/05/72	12/18/72	1/02/73	1/16/73	1/30/73	2/13/73
pH							
	2A						
	2B						
	2C						
	2D	6.1	6.1	6.0	6.1	6.0	6.1
CONDUCTIVITY							
	2A						
	2B						
	2C						
	2D	3650	2930	3600	5250	6800	7000
ALKALINITY ($CaCO_3$)							
	2A						
	2B						
	2C						
	2D	2215	1655	2077	3067	4606	4162
ACIDITY ($CaCO_3$)							
	2A						
	2B						
	2C						
	2D	1646	987	1466	1732	2560	2784
HARDNESS							
	2A						
	2B						
	2C						
	2D	740	991	1080	1550	2133	2337
CALCIUM							
	2A						
	2B						
	2C						
	2D	229	370	349	518	652	460

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	2/27/73	3/13/73	3/27/73	4/24/73	5/08/73	5/22/73
pH							
	2A						
	2B	5.6	5.7	5.7	5.55	5.7	
	2C						
	2D	6.0	5.8	5.9	5.58	5.7	5.6
CONDUCTIVITY							
	2A						
	2B	12700	12200	16800	16500	16600	
	2C						
	2D	6300	7100	7050	6750	6600	8000
ALKALINITY ($CaCO_3$)							
	2A						
	2B	13880	9020	10994	10955	12050	
	2C						
	2D	4449	4295	3365	3160	3817	4481
ACIDITY ($CaCO_3$)							
	2A						
	2B	4910	5845	6223	6825	6730	
	2C						
	2D	2594	2910	2078	1403	1612	2191
HARDNESS							
	2A						
	2B	7315	7015	7155	10575	7412	
	2C						
	2D	2172	2417	2033	2070	2261	2750
CALCIUM							
	2A						
	2B	1900	1665	2071	2401	4000	
	2C						
	2D	522	595	591	592	710	853

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	6/05/73	6/19/73	7/03/73	7/17/73	7/31/73	8/14/73
pH							
	2A	5.0	4.9	5.1	5.15	6.2	5.7
	2B	5.3	5.2	5.2	5.15	5.5	5.6
	2C		6.1	5.9	5.9	5.9	5.9
	2D	5.4	5.5	5.4	5.5	5.6	5.6
CONDUCTIVITY							
	2A	9500	14200	15000	12000	16000	17000
	2B	11400	15150	16000	14600	17000	18000
	2C		8600	14000	12400	16500	18000
	2D	8500	12600	11500	10000	12600	13700
ALKALINITY ($CaCO_3$)							
	2A	3884	5450	6705	8219	11535	11231
	2B	6673	8629	8460	9102	11625	12024
	2C		5494	9690	11497	12525	13054
	2D	4391	5992	5805	6961	6930	7218
ACIDITY ($CaCO_3$)							
	2A	4120	6720	5898	5981	3452	4622
	2B	6131	6675	6569	6843	5898	5634
	2C		3071	4651	4498	4507	5061
	2D	3353	2670	2541	2967	3069	3178
HARDNESS							
	2A		7067	5367	6100	7005	6850
	2B	4625	7200	6150	6950	7401	7775
	2C		2833	3667	7050	8613	8575
	2D	2367	4084	5550	4400	4785	4700
CALCIUM							
	2A	1428	1967	1918	2280	2474	2262
	2B	1701	2208	2208	2525	2839	2581
	2C		887	2010	2475	3101	2871
	2D	880	988	1136	1365	1460	1392

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	8/28/73	9/11/73	9/25/73	10/09/73	10/23/73	11/07/73
pH							
	2A	5.45	5.4	5.4	4.4	5.3	5.3
	2B	5.6	5.6	5.55	4.65	5.5	5.6
	2C	5.75	5.7	5.6	4.7	5.5	5.5
	2D	5.6	5.6	5.6	4.6	5.5	5.5
CONDUCTIVITY							
	2A	15750	14000	10000	14000	10000	15000
	2B	17000	16000	12400	17000	13200	17500
	2C	17000	17250	12400	17000	12800	10000
	2D	13200	13800	10600	11000	9000	13800
ALKALINITY ($CaCO_3$)							
	2A	10656	9578	8687	1437	8165	7703
	2B	11988	11881	11905	3279	11846	11771
	2C	12965	13263	12978	3505	11950	12829
	2D	8081	8253	8091	1761	7659	8016
ACIDITY ($CaCO_3$)							
	2A	5008	4714	5580	6590	4522	4137
	2B	5152	4906	6157	6830	5676	4858
	2C	5296	5628	7504	8514	5964	5724
	2D	3467	3752	4137	4666	3848	4040
HARDNESS							
	2A	6809	6275	5775	5850	5717	5365
	2B	8140	8250	8350	8300	8850	8300
	2C	8870	9025	8625	8475	8500	9175
	2D	5159	5117	4900	4350	5083	5575
CALCIUM							
	2A	2073	1906	1883	1941	1504	1651
	2B	2453	2461	2529	2824	2477	2554
	2C	2750	2759	2731	2839	2389	2741
	2D	1438	1509	1493	1388	973	1566

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	11/20/73	12/04/73	12/18/73	1/15/74	1/29/74	2/12/74
pH							
	2A	5.5	5.8	5.6	5.0		5.0
	2B	5.7	6.0	5.7	5.6		5.1
	2C	5.8	6.1		5.5	5.4	5.2
	2D	5.8	6.0	5.8	5.5	5.0	5.2
CONDUCTIVITY							
	2A	14000	14000	12200	10800	9900	12400
	2B	17000	17800	15200	17000	14400	16800
	2C	18000	18500		16500	13000	18000
	2D	14800	13200	12600	12400	9400	13000
ALKALINITY ($CaCO_3$)							
	2A	8255	8037	8037	7953	7945	6957
	2B	12010	11957	12352	11449	12577	11153
	2C	14587	13959		11463	10560	12687
	2D	8582	7656	8728	8093	6892	8141
ACIDITY ($CaCO_3$)							
	2A	4185	3955	3812	3864	4130	4048
	2B	4680	4479	4384	4414	4923	4830
	2C	5580	5099		4830	4588	4990
	2D	3944	3288	3621	3719	3260	3859
HARDNESS							
	2A	5263	4915	5500	4475	4512	4535
	2B	8350	8689	7600	7075	8500	7490
	2C	10125	9334		7088	7375	8340
	2D	5400	4568	4850	4650	5883	4860
CALCIUM							
	2A	1784	1599	1465	1550	1200	1800
	2B	2726	2474	2531	2300	2200	2900
	2C	3288	2784		2200	2100	3050
	2D	1700	1340	1465	1600	2300	1960

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	2/26/74	3/12/74	3/26/74	4/09/74	4/23/74	5/07/74
pH	2A	5.1	4.5	4.6	4.8	5.0	
	2B	5.3	5.1	4.7	5.1	5.1	4.4
	2C	5.4	4.9	5.1	4.95	5.0	4.8
	2D	5.3	4.9	4.7	5.2	5.3	
CONDUCTIVITY	2A	10600	12000	10000	10000	9300	11400
	2B	17000	17500	14400	14400	13200	13800
	2C	16500	19000	16000	14800	12500	12200
	2D	14400	14200	10400	9000	10000	11600
ALKALINITY ($CaCO_3$)	2A	6420	6315	6578	6504	5325	5781
	2B	11010	10819	10928	10453	9050	9096
	2C	12550	12290	13054	11043	8688	10135
	2D	8963	8245	6784	5770	6108	7037
ACIDITY ($CaCO_3$)	2A	3792	3864	3690	3917	3806	3690
	2B	4444	4444	4410	4072	4178	4154
	2C	5118	4685	5284	4386	4275	4202
	2D	5057	3671	3227	2570	3381	3453
HARDNESS	2A	3930	4025	4350	4259	4150	3764
	2B	7127	7880	7313	6815	6725	6482
	2C	8010	8330	8575	7289	6550	7115
	2D	5174	5070	4275	4092	4263	4286
CALCIUM	2A	1400	2050	1320	1430	1440	1150
	2B	2400	3100	2200	2244	2170	1900
	2C	2600	3350	2660	2310	2080	1900
	2D	1760	2200	1140	1210	1340	1150

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	5/21/74	6/04/74	6/18/74	7/02/74	7/16/74	7/30/74
pH							
	2A	5.0	5.2	4.8	5.3	5.0	5.0
	2B	5.1	5.5	5.3	5.5	5.3	5.2
	2C	5.2	5.6	5.5	5.5	5.4	5.3
	2D	5.2	5.4	5.2	5.4	5.4	5.3
CONDUCTIVITY							
	2A	8600	3600	2800	6300	8000	8000
	2B	1080	6600	4000	1100	10000	10000
	2C	1350		6200	4500	6500	7800
	2D	1600	3500	7200	5400	9700	15000
ALKALINITY ($CaCO_3$)							
	2A	5953	5954	5394	6027	5627	5155
	2B	9448	9429	8600		8485	8177
	2C	11020	10983	8239	9355	9516	9596
	2D	8164	8320	8364	6710	6285	7041
ACIDITY ($CaCO_3$)							
	2A	3824	3853	3728	3596	3734	3471
	2B	4267	4283	4044	3963	3891	3528
	2C	4341	4637	6668	3533	4030	4033
	2D	3824	3805	4321	2729	3317	3442
HARDNESS							
	2A	3740	4069	3678	3419	3238	3179
	2B	6211	6644	6060	6286	5585	
	2C	7232	7416	7435	5830	6250	6506
	2D	4952	5485	5593	3838	3741	4418
CALCIUM							
	2A		1236		840	1230	1172
	2B		1770		1290	2120	1957
	2C		2130		1680	2400	2203
	2D		1368		720	1330	1547

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	8/13/74	8/27/74	9/10/74	9/24/74	10/08/74	10/22/74
pH	2A	4.9	4.9	4.8	5.2	5.2	5.1
	2B	5.3	5.2	4.9	5.3	5.4	5.2
	2C	5.3	5.2	5.0	5.3	5.4	5.3
	2D	5.2	5.3	5.0	5.4	5.4	5.3
CONDUCTIVITY	2A	5200	4500	11800	13400	9600	8200
	2B	6800	9800	16250	16200	12400	10400
	2C	9000	12000	20000	20500	14000	12400
	2D	16000	11800	15500	15500	13200	11500
ALKALINITY ($CACO_3$)	2A	5055	4970	4743	4191	5295	5883
	2B	8226	7991	7599	6407	9763	8494
	2C	10189	10564	10353	9091	12084	12588
	2D	8162	8107	5738	4788	7669	7367
ACIDITY ($CaCO_3$)	2A	3456	3633	3743	3791	3537	3824
	2B	3509	3499	3504	3518	3537	4015
	2C	4426	4479	4780	4570	4971	5258
	2D	3609	3705	3012	2882	3107	3442
HARDNESS	2A	7075	3147	2998	2942	2906	2956
	2B	5648	5443	5261	5108	5041	5125
	2C	7075	7092	7021	7279	7082	7358
	2D	4735	4772	3479	3480	3725	3707
CALCIUM	2A	1550	1425	940	1250	1545	1260
	2B	2550	2600	1750	2250	2600	1445
	2C	2935	3180	2450	3055	3530	2100
	2D	2050	1800	1150	1440	1770	1850

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	11/05/74	11/19/74	12/03/74	12/17/74	1/14/75	1/28/75
pH							
	2A	5.1	5.1	5.1	5.2	5.0	4.9
	2B	5.2	5.0	5.2	5.1	5.2	5.1
	2C	5.8	5.1	5.3	5.2	5.3	5.3
	2D	5.6	5.1	5.3	5.45	5.7	5.2
CONDUCTIVITY							
	2A	3000	7400	6600	3600	6000	7400
	2B	5200	11200	9400	12400	8200	10300
	2C	7000	14000	12200	6000	10000	13200
	2D	6200	9000	10800	5200	6400	7200
ALKALINITY ($CaCO_3$)							
	2A	5179	3890	5430	5308	3796	3496
	2B	7790	6537	7874	7946	6534	6688
	2C	11788	9650	12217	12109	8859	10463
	2D	7154	6743	5531	4652	3733	4272
ACIDITY ($CaCO_3$)							
	2A	3728	3844	3738	3640	3962	3764
	2B	3776	3490	3881	3783	3928	3764
	2C	5425	5449	5378	4742	4498	4752
	2D	3489	3996	2964	2508	2657	2681
HARDNESS							
	2A	3010	2854	3058	2992	3080	3282
	2B	5124	4872	5045	5040	5113	5632
	2C	7319	7282	7520	7296	6700	7616
	2D	3973	4163	3184	2675	2958	2949
CALCIUM							
	2A	1162	1136	1075	868	975	1081
	2B	2044	1859	1980	1460	1740	1876
	2C	2829	2684	2725	2275	2450	2521
	2D	1442	1538	1055	728	725	954

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	2/11/75	2/25/75	3/11/75	3/25/75	4/08/75	4/22/75
pH	2A	5.1	5.1	5.0	5.0	4.9	5.1
	2B	5.2	5.2	5.2	5.2	5.2	5.3
	2C	5.4	5.5	5.4	5.2	5.3	5.4
	2D	5.3	5.5	5.3	5.3	5.2	5.4
CONDUCTIVITY	2A	6400	6000	5600	5000	5100	7000
	2B	8300	7400	7800	7200	7200	9400
	2C	10800	5200	8600	5300	7400	10400
	2D	6400	4700	6000	4200	6100	8300
ALKALINITY ($CaCO_3$)	2A	4779	6181	5891	4402	4804	3673
	2B	8396	9439	8869	6978	7200	5785
	2C	12268	5318	9704	4522	7203	6118
	2D	5970	4530	5563	3310	4917	4830
ACIDITY ($CaCO_3$)	2A	4037	3681	3769	3600	3467	3274
	2B	3779	3749	3853	3482	3491	3321
	2C	4424	1832	3729	2342	3212	3359
	2D	2974	2076	2770	1836	2446	2876
HARDNESS	2A	3258	3387	3492	2958	2602	2673
	2B	5276	5302	5642	4779	4223	4514
	2C	7381	3816	5927	3458	4199	4674
	2D	3121	4648	5253	3320	2647	3315
CALCIUM	2A	965	780	800	655	815	865
	2B	1600	1700	1300	1210	1200	1375
	2C	1560	610	1450	650	1250	1450
	2D	930	350	625	405	805	975

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	5/06/75	5/20/75	6/03/75	6/17/75	7/01/75	7/15/75
pH							
	2A	5.1	5.0	4.9	5.0	5.0	4.7
	2B	5.2	5.3	5.1	5.1	5.2	5.0
	2C	5.3	5.3	5.1	5.3	5.1	4.9
	2D	5.4	5.4	5.2	5.2	5.6	5.2
CONDUCTIVITY							
	2A	8448	7690	8075	6912	6200	4995
	2B	12900	11461	10710	9720	8400	7290
	2C	11700	13031	13260	10044	8200	7830
	2D	7910	10362	10200	6480	8640	9880
ALKALINITY ($CaCO_3$)							
	2A	3452.5	3498	3487	3618	3186	3011
	2B	5507.5	5360	5269	4996	4326	4499
	2C	6051.5	6821	6597	5508	4333	4733
	2D	3843.5	4646	4103	3287	3078	4055
ACIDITY ($CaCO_3$)							
	2A	3334.5	3453	3614	3600	3389	2795
	2B	3230.5	3216	3212	3132	3085	2618
	2C	3245	3642	3759	3460	3272	3756
	2D	2544.5	3358	2786	2324	2407	2627
HARDNESS							
	2A	2659.5	2630	2583	2411	2300	2200
	2B	4308.5	1646	3968	3600	3415	3338
	2C	4657.5	1959	4712	3886	3358	3317
	2D	2637	1182	2583	2210	2250	2713
CALCIUM							
	2A	930	950	800	795	670	619
	2B	1350	1510	1350	1063	960	1000
	2C	1400	1755	1800	1050	933	1000
	2D	860	925	850	635	575	715

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	7/29/75	8/12/75	8/26/75	9/09/75	9/23/75	10/07/75
pH							
	2A	4.9	5.1	4.7	4.9	4.9	4.9
	2B	5.1	5.3	4.9	5.1	4.9	5.1
	2C	5.0	5.2	4.9	5.0	5.1	5.0
	2D	5.2	5.4	5.3	5.3	5.3	5.3
CONDUCTIVITY							
	2A	6500	4625	6345	6240	4680	5106
	2B	6760	6500	8370	7800	6240	7326
	2C	10920	8250	11610	9620	7440	8430
	2D	9880	9250	7326	10660	6960	7548
ALKALINITY ($CaCO_3$)							
	2A	2974	2971	3121	3264	3100	3283
	2B	4761	4511	4502	4555	4250	4427
	2C	5176	5526	5906	6494	6389	6376
	2D	4818	4805	4259	5010	4628	4779
ACIDITY ($CaCO_3$)							
	2A	935	2928	3018	3104	3004	3104
	2B	905	2728	2666	2713	2613	2647
	2C	1210	4189	4460	4474	4574	4212
	2D	918	3118	2764	2952	3042	2846
HARDNESS							
	2A	1975	2025	2075	2010	2494	2000
	2B	3400	3300	3225	3200	4187	2900
	2C	3588	3963	4175	4375	5625	4406
	2D	2925	3075	2600	2838	3872	2694
CALCIUM							
	2A	665	568	820	495	489	
	2B	1100	853	1030	900	720	
	2C	1050	920	1400	1400	2070	
	2D	900	715	880	805	600	

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	10/21/75	11/04/75	11/18/75	12/02/75	12/16/75	1/02/76
pH							
	2A	4.9	5.0	4.8	4.8	5.0	4.9
	2B	5.1	5.2	5.0	4.5	5.3	5.2
	2C	5.2	5.2	5.0	4.4	5.2	5.2
	2D	5.5	5.4	5.2	4.6	5.3	5.3
CONDUCTIVITY							
	2A	6370	5390	6136	5400	6990	5658
	2B	8060	6820	7440	7020	8556	6720
	2C	9360	9240	8840	9726	11868	6580
	2D	4550	5830	8160	8250	7728	4340
ALKALINITY ($CaCO_3$)							
	2A	3181	5595	3338	3537	3280	3470
	2B	4068	6420	4177	4548	4207	5115
	2C	4523	10458	7306	7834	6301	6814
	2D	2051	5668	4734	4796	489	3514
ACIDITY ($CaCO_3$)							
	2A	3136	2298	3296	3117	3403	3455
	2B	2579	2027	2746	2731	2737	2953
	2C	2646	3784	4498	4664	4450	4122
	2D	1080	2032	2670	2856	3051	2286
HARDNESS							
	2A	2017	2463	3979	3634	3467	4732
	2B	3111	3691	3313	4298	4190	5428
	2C	3539	6069	6185	6847	10825	7876
	2D	3990	3256	4218	4572	6713	6026
CALCIUM							
	2A	789	813	733	765	888	807.5
	2B	1275	1030	1079	969	550	930
	2C	955	1800	1747	1912	1430	1335
	2D	459	770	820	867	890	610

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	2/03/76	2/17/76	3/02/76	3/16/76	3/30/76	4/13/76
pH	2A	4.9	4.9	4.9	4.9	5.0	5.0
	2B	5.0	5.2	5.3	5.1	5.2	5.2
	2C	5.2	5.2	5.3	5.2	5.2	5.3
	2D	5.1	5.2	5.3	5.3	5.2	5.4
CONDUCTIVITY	2A	5480	4625	4872	7300	8150	6610
	2B	7124	6500	6612		9670	6610
	2C	8768	10750	8120	12500	1500	11100
	2D	6302	6500	5452	7700	8910	8760
ALKALINITY ($CaCO_3$)	2A	3652					
	2B	4756					
	2C	6732					
	2D	3629					
ACIDITY ($CaCO_3$)	2A	3459					
	2B	2934					
	2C	4117					
	2D	2445					
HARDNESS	2A	3108					
	2B	4027					
	2C	6080					
	2D	2987					
CALCIUM	2A	792					
	2B	1065					
	2C	1450					
	2D	660					

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	4/27/76	5/11/76	5/25/76	6/08/76	6/23/76	7/06/76
pH							
	2A	5.04	5.2	5.0	5.0	5.0	5.0
	2B	5.29	5.3	5.2	5.2	5.2	5.2
	2C	5.3	5.3	5.2	5.2	5.2	5.15
	2D	5.51	5.4	5.5	5.5	5.5	5.40
CONDUCTIVITY							
	2A	2400	6140	7399	6936		6480
	2B	2650	6974	9125	7730		7450
	2C	800	10937	12578	8324		9720
	2D	3000	7811	7275	7064		6030
ALKALINITY ($CaCO_3$)							
	2A	3116					
	2B	3936					
	2C	6642					
	2D	4510					
ACIDITY ($CaCO_3$)							
	2A	3262					
	2B	2533					
	2C						
	2D	3054					
HARDNESS							
	2A	2863					
	2B	3850					
	2C	N.A.					
	2D	4256					
CALCIUM							
	2A	871					
	2B	1133					
	2C	1980					
	2D	960					

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	7/20/76	8/03/76	8/17/76	8/31/76	9/14/76	9/28/76
pH							
	2A	5.0	5.0	4.95	4.8	4.9	4.9
	2B	5.2	5.1	5.15	5.1	4.9	5.2
	2C	5.2	5.1	5.2	5.0	5.0	5.2
	2D	5.45	5.5	5.4	5.6	6.0	5.5
CONDUCTIVITY							
	2A		6760	5000	5500	7192	7168
	2B	7700	5950	5800	4990	8432	7840
	2C	9010	9380	6800	8960	12648	8288
	2D	6160	6940	6200	7780	8800	7168
ALKALINITY ($CaCO_3$)							
	2A	3501	3422	1994	2987	3296	2865
	2B	4493	4134	3012	3811	4356	3932
	2C	5882	5705	4814	5682	5932	4196
	2D	4224	4038	3772	4542	5062	3330
ACIDITY ($CaCO_3$)							
	2A	3365	3186	3723	3007	3716	3619
	2B	2870	2586	3077	2899	2787	2747
	2C	3678	3546	4373	4191	4238	2806
	2D	2665	2637	3123	3197	3115	2509
HARDNESS							
	2A		2505	2352	2163	2294	2160
	2B	3284	3141	3261	2908	2844	3348
	2C	4154	4454	4521	4492	4353	3048
	2D	2222	2264	2568	2632	2378	2484
CALCIUM							
	2A	900	875	654	800	780	655
	2B	952	1070	848	986	985	835
	2C	2900	1500	1925	1900	1320	790
	2D	843	920	668	883	790	468

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	10/12/76	10/26/76	11/09/76	11/23/76	12/07/76
pH						
	2A	4.8	5.1	5.1	4.8	4.9
	2B	5.2	5.3	5.3	5.0	5.2
	2C	5.1	5.3	5.2	4.9	5.1
	2D	5.4	5.5	5.4	5.3	5.6
CONDUCTIVITY						
	2A	7480	6888	7200	6968	5896
	2B	8360	7872	8280	7772	7772
	2C	10010	8610	7720	9112	9380
	2D	7810	7134	13688	8844	8308
ALKALINITY ($CaCO_3$)						
	2A	3661	2729	2848	3002	5648
	2B	4162	3373	3621	3589	6584
	2C	4874	3535	3689	4328	8121
	2D	4424	3610	5976	4424	7273
ACIDITY ($CaCO_3$)						
	2A	3441	4179	3961	3904	4010
	2B	2709	3232	3267	3257	3161
	2C	3561	3677	3887	4105	4383
	2D	2805	3445	4596	3410	3610
HARDNESS						
	2A	2308	3481	2390	2275	2212
	2B	2976	3994	3114	3172	3103
	2C	3844	4146	3310	3769	3828
	2D	2217	3546	4173	2660	2618
CALCIUM						
	2A	800	540	722	718	591
	2B	925	665	861	1035	885
	2C	1030	640	912	1125	900
	2D	770	513	1102	852	699

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	9/25/72	10/02/72	10/10/72	10/24/72	11/07/72	11/20/72
MAGNESIUM							
	2A						
	2B						
	2C						
	2D	42	47	52	25	51	59
IRON							
	2A						
	2B						
	2C						
	2D						
MANGANESE							
	2A						
	2B						
	2C						
	2D	15	19	21	50	21	21
ZINC							
	2A						
	2B						
	2C						
	2D						
COPPER							
	2A						
	2B						
	2C						
	2D						
LEAD							
	2A						
	2B						
	2C						
	2D						

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	12/05/72	12/18/72	1/02/73	1/16/73	1/30/73	2/13/73
MAGNESIUM							
	2A						
	2B						
	2C						
	2D	42	61	77	108	137	150
IRON							
	2A						
	2B						
	2C						
	2D	822	430	453	716	1010	1064
MANGANESE							
	2A						
	2B						
	2C						
	2D	20	11	13	21	28	25.1
ZINC							
	2A						
	2B						
	2C						
	2D			2.7		4.4	3.6
COPPER							
	2A						
	2B						
	2C						
	2D						
LEAD							
	2A						
	2B						
	2C						
	2D						<0.5

LEACHATE-SAMPLE CONCENTRATIONS

	TEST CELL	2/27/73	3/13/73	3/27/73	4/24/73	5/08/73	5/22/73
MAGNESIUM							
	2A						
	2B	439	450	487	566	604	
	2C						
	2D	142	180	131	132	145	183
IRON							
	2A						
	2B			1950	2902	2363	
	2C						
	2D	793	790	653	592	536	842
MANGANESE							
	2A						
	2B			98	97.6	115	
	2C						
	2D	20.2	29	25	19.8	29	28
ZINC							
	2A						
	2B				240	255	
	2C						
	2D				16.9	17.9	
COPPER							
	2A						
	2B				N.D.	.12	
	2C						
	2D				N.D.	.05	
LEAD							
	2A						
	2B				N.D.	2.76	
	2C						
	2D				N.D.	.27	

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	6/05/73	6/19/73	7/03/73	7/17/73	7/31/73	8/14/73
MAGNESIUM	2A	293	442	408	453	486	471
	2B	384	530	473	522	565	561
	2C		195	391	471	576	581
	2D	204	281	279	340	265	355
IRON	2A	1100	1105	1268	1281	1507	1547
	2B	1825	1250	1178	1302	1465	1630
	2C		1454	1821	2016	2176	2321
	2D	700	723	571	777	837	995
MANGANESE	2A	109	99	82	79	80	82
	2B	79	74	75	76	75	82
	2C		39	80	87	96	106
	2D	32	38	41	46	45	58
ZINC	2A			122	150	112	113
	2B			231	360	294	310
	2C			47	68	70	71
	2D			67	64	59	60
COPPER	2A					0.05	0.04
	2B					0.05	0.03
	2C					0.04	0.06
	2D					0.02	0.04
LEAD	2A					0.08	0.55
	2B					3.0	N.D.
	2C					0.2	N.D.
	2D					0.2	N.D.

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	8/28/73	9/11/73	9/25/73	10/09/73	10/23/73	11/07/73
MAGNESIUM							
	2A	458	424	376	360	365	341
	2B	564	569	543	562	617	561
	2C	583	589	539	518	580	571
	2D	384	400	388	324	374	399
IRON							
	2A	1263	1092	917	851	800	704
	2B	1506	1484	1509	1621	1200	1309
	2C	2326	2499	2780	2521	1600	1946
	2D	1019	1132	1183	846	1000	1141
MANGANESE							
	2A	59	49	40	40	39	37
	2B	68	69	62	60	69	59
	2C	91	83	77	73	81	77
	2D	48	49	49	40	51	54
ZINC							
	2A	105	75	86	88	77	68
	2B	250	298	241	353	300	250
	2C	75	83	70	71	86	78
	2D	60	60	56	50	51	50
COPPER							
	2A	0.08	0.08			0.10	
	2B	0.08	0.08			N.D.	
	2C	.09	0.07			N.D.	
	2D	.07	0.05			N.D.	
LEAD							
	2A	0.40	0.63			N.D.	
	2B	0.8	1.25			1.9	
	2C	N.D.	0.63			N.D.	
	2D	N.D.	0.12			N.D.	

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	11/20/73	12/04/73	12/18/73	1/15/74	1/29/74	2/12/74
MAGNESIUM							
	2A	330	316	284	306	260	220
	2B	522	510	545	448	480	460
	2C	514	571		448	400	700
	2D	411	326	363	330	260	220
IRON							
	2A	676	681	662	624	540	600
	2B	1279	1250	1361	900	780	800
	2C	2000	1778		960	820	1080
	2D	1135	944	1065	878	700	880
MANGANESE							
	2A	35	33	30	30	27	22
	2B	53	56	56	32	43	39
	2C	74	75		48	52	58
	2D	55	50	56	40	39	47
ZINC							
	2A	57	60	54	51	62	64
	2B	187	200	187	136	180	240
	2C	83	95		78	80	126
	2D	38	36	37	48	40	56
COPPER							
	2A				N.D.		
	2B				N.D.		
	2C				N.D.		
	2D				N.D.		
LEAD							
	2A				N.D.		
	2B				N.D.		
	2C				N.D.		
	2D				N.D.		

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	2/26/74	3/12/74	3/26/74	4/09/74	4/23/74	5/07/74
MAGNESIUM							
	2A	247	292	225	234	228	207
	2B	466	544	466	426	400	345
	2C	521	594	545	439	369	357
	2D	370	398	277	234	267	268
IRON							
	2A	515	520	530	500	521	563
	2B	828	810	870	750	668	692
	2C	1183	1100	1270	850	800	865
	2D	1041	965	800	550	690	995
MANGANESE							
	2A	16	23	23	23	23	23
	2B	38	38	37	32	33	32
	2C	58	53	59	42	37	43
	2D	51	48	37	29	31	41
ZINC							
	2A	49	50	45	42	41	39
	2B	200	177	157	150	132	116
	2C	146	112	108	66	66	87
	2D	56	52	50	35	46	46
COPPER							
	2A		0.21				
	2B		0.11				
	2C		0.11				
	2D		0.11				
LEAD							
	2A						
	2B						
	2C						
	2D						

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	5/21/74	6/04/74	6/18/74	7/02/74	7/16/74	7/30/74
MAGNESIUM							
	2A		200		210	220	260
	2B		329		383	350	395
	2C		390		360	390	450
	2D		358		270	270	375
IRON							
	2A		551		525	520	520
	2B		835		640	570	568
	2C		1169		750	755	840
	2D		1169		770	729	960
MANGANESE							
	2A	22	22	22	20.3	20.7	21
	2B	33	35	31	29.5	27.7	27
	2C	50	51	47	34.8	40.28	45
	2D	49	47	49	33	35.9	42
ZINC							
	2A	35	35	30	28	37.5	38.6
	2B	107	85	84	86	60.8	62
	2C	69	61	63	40	48.3	51
	2D	40	37	35	29	37.5	42.4
COPPER							
	2A		0.13		0.09		<0.2
	2B		0.13		0.09		<0.2
	2C		0.13		0.08		<0.2
	2D		0.13		0.07		0.2
LEAD							
	2A				0.09		
	2B				0.088		
	2C				0.092		
	2D				0.07		

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	8/13/74	8/27/74	9/10/74	9/24/74	10/08/74	10/22/74
MAGNESIUM							
	2A	220	100	50	104	85	80
	2B	400	255	98	190	182	165
	2C	485	365	230	336	330	318
	2D	400	250	69	160	157	148
IRON							
	2A	524	510	543	528	608	553
	2B	593	535	596	528	605	605
	2C	878	945	965	600	950	625
	2D	1032	1000	690	775	935	885
MANGANESE							
	2A	18	18.8	20	23	20	20.5
	2B	26	24.3	24.5	28	23	24
	2C	46.4	49	53	63	57	60
	2D	46.7	45	32	50	39	36
ZINC							
	2A	41	32.5	26	37	30	30
	2B	100	78	66	70	70	66
	2C	74	68.6	61	65	115	63
	2D	48	36	22	26	29	28
COPPER							
	2A	N.A.	0.92	1.15	0.70		0.03
	2B		0.5	1.34	0.89		0.04
	2C		1.0	1.34	0.75		0.03
	2D		0.5	1.66	0.90		0.02
LEAD							
	2A	N.A.		N.D.	N.D.		<0.05
	2B			N.D.	N.D.		<0.05
	2C			N.D.	N.D.		<0.05
	2D			N.D.	N.D.		<0.05

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	11/05/74	11/19/74	12/03/74	12/17/74	1/14/75	1/28/75
MAGNESIUM							
	2A	121	109	80	75	128	151
	2B	208	187	150	150	235	261
	2C		301	319	290	318	427
	2D	184	196	96	71	118	158
IRON							
	2A	608	582	525	583	625	600
	2B	617	573	590	618	625	645
	2C	1228	1170	1200	1105	953	1060
	2D	949	1170	775	675	639	693
MANGANESE							
	2A	19.5	20	20.5	20	20.6	19.5
	2B	24	23.5	25.4	26	25.9	25.6
	2C	45	65	69.7	68	55	67.6
	2D	37.9	41	31.8	26	24.3	26.9
ZINC							
	2A	27.6	29	24	31.1	35.2	37.8
	2B	70	73	71.6	72	75.5	83
	2C	66.5	72	75	169	70.4	84.4
	2D	28.3	30	18	21	22.4	29
COPPER							
	2A		∠0.09		.0438	∠0.10	
	2B		∠0.09		.0292	∠0.10	
	2C		∠0.09		.0292	∠0.10	
	2D		∠0.09		.0292	∠0.10	
LEAD							
	2A		∠0.81		.036	0.0274	
	2B		∠0.81		.084	0.072	
	2C		∠0.81		199	0.1249	
	2D		∠0.81		.032	0.0252	

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	2/11/75	2/25/75	3/11/75	3/25/75	4/08/75	4/22/75
MAGNESIUM							
	2A	106	145	94	130	150	88
	2B	175	260	163	325	195	163
	2C	307	170	196	135	210	174
	2D	123	120	94	100	145	134
IRON							
	2A	660	650	587	588	573	582
	2B	650	675	604	600	540	530
	2C	825	495	770	385	600	663
	2D	860	560	679	473	658	813
MANGANESE							
	2A	22	21.1	26	17.4	15	14
	2B	27	27.8	32.8	23.1	20	20
	2C	70	24.4	50.9	19.6	28	32
	2D	32	20.9	34.8	18.9	25	30
ZINC							
	2A	25	33	24.2	30	32	29
	2B	51	80	55.7	57	62	67
	2C	51	29	36	29	49	51
	2D	17	20	15.3	31	27	34
COPPER							
	2A	≤ .1		≤ 0.146		0.092	
	2B	≤ .1		≤ 0.146		0.0345	
	2C	≤ .1		≤ 0.146		0.0345	
	2D	≤ .1		≤ 0.146		N.D.	
LEAD							
	2A	.029		0.038		0.0359	
	2B	.050		0.089		0.0563	
	2C	.079		0.120		0.0762	
	2D	.026		0.040		0.0544	

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	5/06/75	5/20/75	6/03/75	6/17/75	7/01/75	7/15/75
MAGNESIUM							
	2A	106.5	94	75	88	84	67.3
	2B	185	122	148	145	126	122
	2C	195.5	159	198	173	129	122
	2D	141.5	92	120	89	97.4	114
IRON							
	2A	560	585	574	555	578	562
	2B	505	665	510	508	450	476
	2C	560	1230	668	535	574	608
	2D	587.5	1435	730	545	600	741
MANGANESE							
	2A	13.8	15.4	15.4	15.0	13.5	12.2
	2B	19	20.7	21.3	17.8	16.0	15.1
	2C	28.5	39.0	46.8	27.8	26.1	25.4
	2D	22.5	31	27.9	21.2	22.2	25.5
ZINC							
	2A	27.5	20.0	24.0	20	21.2	19.0
	2B	64.2	43	57.8	39	43.4	49.6
	2C	46.3	37.5	42.0	35	38.1	38.1
	2D	25.2	17.5	19.5	14	15.9	20.3
COPPER							
	2A	≤ 0.111			≤ 0.1		
	2B	≤ 0.111			≤ 0.1		
	2C	≤ 0.111			≤ 0.1		
	2D	≤ 0.111			≤ 0.1		
LEAD							
	2A	0.07					
	2B	0.07			0.279		
	2C	0.07			0.112		
	2D	0.07			0.083		

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	7/29/75	8/12/75	8/26/75	9/09/75	9/23/75	10/07/75
MAGNESIUM	2A	80.0	79.5	91.0	87.0		
	2B	155	141.1	130	128		
	2C	161	179.2	170	180		
	2D	158	160.2	110	140		
IRON	2A	555	560	578	590	434	
	2B	465	500	455	490	402	
	2C	640	695	705	795	702	
	2D	850	885	805	955	702	
MANGANESE	2A	11.0	12.17	11.9	12.3	11.3	
	2B	14.5	15.63	16.5	14.9	13.6	
	2C	30.0	35.88	40.8	46.5	46.0	
	2D	29.5	30.72	25.8	30.3	26.3	
ZINC	2A	18.4	19.9	16.0	18.5	17.2	
	2B	52.0	44.0	34.0	40.0	37.5	
	2C	38.0	38.0	33.0	38.0	42.9	
	2D	19.4	21.1	11.0	14.1	11.8	
COPPER	2A		∠0.017	0.058	0.011	.024	
	2B		∠0.017	0.060	0.014		
	2C		∠0.017	0.074	0.005	.046	
	2D		∠0.017	0.074	0.003		
LEAD	2A		∠0.030	0.174	0.009		
	2B		∠0.030	0.183	0.010		
	2C		∠0.030	0.304	0.010		
	2D		∠0.030	0.270	0.010		

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	10/21/75	11/04/75	11/18/75	12/02/75	12/16/75	1/02/76
MAGNESIUM							
	2A	71.5	81	72.1	73	85.9	92.4
	2B	87.5	117	108	79	160	130.5
	2C	98	200	180	156	166	191.5
	2D	53.3	97	120	80	120	100
IRON							
	2A	602	612	579	592	638	700
	2B	472	482	485	480	505	574
	2C	566	904	864	876	871	821
	2D	460	783	842	840	865	760
MANGANESE							
	2A	11.8	12.6	13.6	11.9	13.5	14.05
	2B	14.1	14.3	15.3	14.7	15.2	17.2
	2C	34.5	55	61	60	49.5	41
	2D	11	20.6	26.2	24.7	28.2	20.15
ZINC							
	2A			18.6		19.3	19.1
	2B			3.1		32	39.3
	2C			4.1		38	39.4
	2D			3.6		6.1	
COPPER							
	2A	.032		.019		.037	
	2B	.028		.03		.03	
	2C	.23		.021		.033	
	2D	.025		.031		.026	
LEAD							
	2A	.017		.024		.007	
	2B	.017		.024		.018	
	2C	.019		.033		.022	
	2D	.02		.026		.029	

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	2/03/76	2/17/76	3/02/76	3/16/76	3/30/76	4/13/76
MAGNESIUM							
	2A	93					
	2B	119					
	2C	195.5					
	2D	91					
IRON							
	2A	638	360	694	673	658	674
	2B	586	290.5	502	576	519	557
	2C	810.5	440	643	863	855	931
	2D	782.5	486	625	863	934	1105
MANGANESE							
	2A	14.6					
	2B	11.2					
	2C	44.5					
	2D	20.5					
ZINC							
	2A						
	2B						
	2C						
	2D						
COPPER							
	2A						
	2B						
	2C						
	2D						
LEAD							
	2A		0.034	< 0.01	0.0179	0.008	0.01
	2B		0.046	0.011	0.0145	0.015	0.006
	2C		0.052	0.016	0.0291	0.029	0.008
	2D		0.056	< 0.01	0.0107	0.023	0.006

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	4/27/76	5/11/76	5/25/76	6/08/76	6/23/76	7/06/76
MAGNESIUM							
	2A	72					
	2B	94					
	2C	228					
	2D	119					
IRON							
	2A	673	700	786	797	795	649
	2B	519	610	646	608	578	817
	2C	779	975	1012	682	718	777
	2D	1120	1500	1132	990	915	906
MANGANESE							
	2A	18.9					
	2B	18.3					
	2C	31.5					
	2D	38.6					
ZINC							
	2A	8.1					
	2B	22					
	2C	26.0					
	2D	6.0					
COPPER							
	2A	0.038					
	2B	0.032					
	2C	0.073					
	2D	0.040					
LEAD							
	2A	0.002	0.008	0.003	0.139	0.008	0.005
	2B	0.010	0.010	0.005	0.084	0.010	0.010
	2C	0.021	0.016	0.006	0.016	0.006	0.010
	2D	0.014	0.006	0.002	0.008	0.005	0.009

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	7/20/76	8/03/76	8/17/76	8/31/76	9/14/76	9/28/76
MAGNESIUM							
	2A		94				
	2B		206				
	2C		222				
	2D		166				
IRON							
	2A	800	802	787		810	783
	2B	600	630	624	636	607	628
	2C	646	815	816	925	860	585
	2D	1082	1045	1310	1095	1390	1080
MANGANESE							
	2A		15.6				
	2B		16.4				
	2C		36.3				
	2D		24.6				
ZINC							
	2A	18.8	19.8	20.5	20	21	20
	2B	31.6	36	28	28	27.5	27
	2C	33.8	40	36	40	40	23
	2D	5.5	5.4	7	7.8	6	2.1
COPPER							
	2A		.064				
	2B		.070				
	2C		.042				
	2D		.050				
LEAD							
	2A	.0135	.010	.0314	.060	.112	.106
	2B	.0184	.148	.0198	.066	.125	.058
	2C	.0369	.197	.0156	.098	.093	.106
	2D	.0242	.159	.0367	.158	.096	.076

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	10/12/76	10/26/76	11/09/76	11/23/76	12/07/76
MAGNESIUM						
	2A				73.7	
	2B				143	
	2C				187	
	2D				130	
IRON						
	2A	905	84	1004	870	952
	2B	740	705	696	645	670
	2C	850	780	840	695	845
	2D	1345	1270	1452	1250	
MANGANESE						
	2A				12.7	
	2B				13.6	
	2C				23.9	
	2D				26.5	
ZINC						
	2A	26	22	24	20.6	20
	2B	32	33	31	30.5	28.3
	2C	36	27	34	33	33.5
	2D	5.6	53	35	6.4	13.1
COPPER						
	2A				.0355	
	2B				.037	
	2C				.0402	
	2D				.037	
LEAD						
	2A	.14	.0691	.023	.0249	.058
	2B	.1356	.0726	.0464	.0271	.0578
	2C	.1371	.096	.0854	.0384	.0566
	2D	.1144	.123	.0508	.0441	.0793

LEACHATE-SAMPLE CONCENTRATIONS

	TEST CELL	9/25/72	10/02/72	10/10/72	10/24/72	11/07/72	11/20/72
CADMIUM							
	2A						
	2B						
	2C						
	2D						
SODIUM							
	2A						
	2B						
	2C						
	2D	297	603	508	386	393	269
POTASSIUM							
	2A						
	2B						
	2C						
	2D						
CHLORIDE							
	2A						
	2B						
	2C						
	2D	50.4	905	682	668	604	529
SULFATE							
	2A						
	2B						
	2C						
	2D	30.2		29.0	23.4	11.0	18.1
ORTHOPHOSPHATE							
	2A						
	2B						
	2C						
	2D	4.4	6.4	2.4	2.8	1.4	1.5

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	12/05/72	12/18/72	1/02/73	1/16/73	1/30/73	2/13/73
CADMIUM							
	2A						
	2B						
	2C						
	2D						
SODIUM							
	2A						
	2B						
	2C						
	2D	257	178	202	331	485	507
POTASSIUM							
	2A						
	2B						
	2C						
	2D		100	160		353	434
CHLORIDE							
	2A						
	2B						
	2C						
	2D	303	231	339	494	684	915
SULFATE							
	2A						
	2B						
	2C						
	2D	19.6	83.3	43.5	62.2	165.6	243
ORTHOPHOSPHATE							
	2A						
	2B						
	2C						
	2D	1.2	1.1	2.8	3.1	1.7	2.9

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	2/27/73	3/13/73	3/27/73	4/24/73	5/08/73	5/22/73
CADMIUM							
	2A						
	2B				N.D.	N.D.	
	2C						
	2D				N.D.	1.0	
SODIUM							
	2A						
	2B	1040	1190	1368	1519	1625	
	2C						
	2D	411	545	499	488	550	864
POTASSIUM							
	2A						
	2B				1481	1612	
	2C						
	2D				417	490	1028
CHLORIDE							
	2A						
	2B				2176	2270	
	2C						
	2D	690	790		540	701	869
SULFATE							
	2A						
	2B			954.1	889	1112	
	2C						
	2D	200	285	386.8	390	225	325
ORTHOPHOSPHATE							
	2A						
	2B	18.5	18.7		64.5	60	
	2C						
	2D	3.4	3.6		17	35	24

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	6/05/73	6/19/73	7/03/73	7/17/73	7/31/73	8/14/73
CADMIUM							
	2A					0.06	N.D.
	2B					0.03	0.01
	2C					0.01	N.D.
	2D					0.02	N.D.
SODIUM							
	2A	1700	1645	1625	1800	1700	1900
	2B	1000	1390	1300	1700	1400	1650
	2C		630	1325	1438	1650	1725
	2D	830	1185	1025	1090	1050	1125
POTASSIUM							
	2A	1132	1900	1650	2225	1900	1900
	2B	1199	1955	1700	2425	1900	1675
	2C		490	1450	1575	1850	1800
	2D	791	938	1175	1350	1270	1200
CHLORIDE							
	2A	3558	1982	1928	2064	2335	2118
	2B	1711	2118	1901	2009	2227	2009
	2C		978	1684	1901	2009	1874
	2D	1113	1466	1195	1412	1358	1358
SULFATE							
	2A	625	1100	980	1290	1306	1190
	2B	805	1250	1200	1365	1446	1400
	2C		415	925	1070	1356	1320
	2D	370	730	760	855	912	960
ORTHOPHOSPHATE							
	2A	203	390	243	260	63	36
	2B	100	185	125	150	97	51
	2C		13	55	48	14	29
	2D	48	51	72	43	82	40

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	8/28/73	9/11/73	9/25/73	10/09/73	10/23/73	11/07/73
CADMIUM							
	2A	N.D.	N.D.			0.14	
	2B	0.01	N.D.			N.D.	
	2C	N.D.	N.D.			N.D.	
	2D	N.D.	N.D.			N.D.	
SODIUM							
	2A	1625	1680	1350	1250	1264	1200
	2B	1400	1650	1330	1300	1445	1263
	2C	1650	1750	1425	1375	1445	1450
	2D	1375	1375	1130	1125	1084	1100
POTASSIUM							
	2A	1800	1708	1457	1864	1293	1300
	2B		1846	1614	2227	1645	2939
	2C	1700	1625	1353	1954	1411	2882
	2D	1300	1240	1249	1273	940	1893
CHLORIDE							
	2A	2178	2040	1874	1984	1874	1874
	2B	2123	1902	2343	2095	2315	2095
	2C	2260	1929	1980	2260	2039	1929
	2D	1764	1461	1682	2260	2150	1654
SULFATE							
	2A	976	915	825	1035	1200	920
	2B	1244	1205	1280	1160	2000	1520
	2C	1324	1025	965	1280	840	1520
	2D	912	850	800	820	1160	1280
ORTHOPHOSPHATE							
	2A	26	16	12	8	8	10
	2B	34	24	11	18	40	25
	2C	11	7	9	7		7
	2D	31	31	26	36	38	31

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	11/20/73	12/04/73	12/18/73	1/15/74	1/29/74	2/12/74
CADMIUM							
	2A				N.D.		
	2B				N.D.		
	2C				N.D.		
	2D				N.D.		
SODIUM							
	2A	1087	1100	1050	900	1000	830
	2B	1188	1250	1300	1000	1200	970
	2C	1525	1513		1130	1200	1160
	2D	1075	975	1150	860	900	900
POTASSIUM							
	2A	1181	1750	1250	1100	1050	1320
	2B	1574	2000	1833	1500	1600	1750
	2C	1759	2150		1400	1380	1900
	2D	1065	1700	1125	1000	880	1400
CHLORIDE							
	2A	1819	1682	1654	1213	1172	1320
	2B	2040	1984	2040	1186	1987	2095
	2C	2591	2205		1874	1654	2153
	2D	2012	1488	1599	1337	1114	1489
SULFATE							
	2A	660	560	520	540	430	420
	2B	1080	1085	880	776	945	830
	2C	1240	1255		784	865	1050
	2D	870	720	720	596	555	745
ORTHOPHOSPHATE							
	2A	10	13	12	25	21	22
	2B	14	13	7	19	26	24
	2C	9	9		18	14	18
	2D	28	30	21	45	46	44

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	2/26/74	3/12/74	3/26/74	4/09/74	4/23/74	5/07/74
CADMIUM							
	2A						
	2B						
	2C						
	2D						
SODIUM							
	2A	900	848	796	795	900	780
	2B	1280	1150	1060	925	1090	920
	2C	1580	1320	1390	1100	1150	1200
	2D	1200	990	776	650	915	850
POTASSIUM							
	2A	1100	948	843	895	805	842
	2B	1730	1625	1470	1400	1680	1224
	2C	1950	1660	1647	1450	1520	1301
	2D	1350	1115	866	700	1035	842
CHLORIDE							
	2A	799	1047	1056	1164	972	1209
	2B	1627	1924	1613	1552	1395	1626
	2C	2123	2150	2255	1676	1647	1675
	2D	1543	1406	1048	866	991	1250
SULFATE							
	2A	460	428	440	324	366	354
	2B	900	796	768	704	734	620
	2C	1150	848	1064	910	764	791
	2D	840	708	604	422	820	685
ORTHOPHOSPHATE							
	2A	43	24	25	23	39	20
	2B	37	16	12	8	46	10
	2C	46	20	19	11	25	8
	2D	56	30	34	32	55	24

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	5/21/74	6/04/74	6/18/74	7/02/74	7/16/74	7/30/74
CADMIUM							
	2A				0.024		
	2B				0.011		
	2C				0.016		
	2D				0.03		
SODIUM							
	2A	655		700	700	500	500
	2B	835		830	900	680	695
	2C	1185		1175	950	950	960
	2D	955		1050	750	630	800
POTASSIUM							
	2A	801	800	825	690	720	695
	2B	1240	975	1300	1150	1225	1050
	2C	1530	1250	1535	1035	1400	1170
	2D	1305	900	1250	690	890	800
CHLORIDE							
	2A		887		929	1085	1209
	2B		1269		1427	1489	1730
	2C		1810		1386	1346	2153
	2D		1277		1003	912	1378
SULFATE							
	2A	430	528	624	493	410	460
	2B	676	999	992	772	605	625
	2C	1004	1121	994	756	865	922
	2D	768	951	994	695	565	845
ORTHOPHOSPHATE							
	2A	22	31	42	31	32.6	32
	2B	7	9	6	5	11	9
	2C	10	30	9	9	7	9
	2D	24	28	26	34	36.5	34.3

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	8/13/74	8/27/74	9/10/74	9/24/74	10/08/74	10/22/74
CADMIUM	2A	N.A.		N.D.	N.D.		0.1
	2B			N.D.	N.D.		0.1
	2C			N.D.	N.D.		0.1
	2D			N.D.	N.D.		0.1
SODIUM	2A	500	450	400	525	450	445
	2B	665	640	725	950	575	520
	2C	970	940	975	1300	1050	1025
	2D	820	775	650	600	630	575
POTASSIUM	2A	675	625	625	605	635	640
	2B	1180	1000	960	918	930	890
	2C	1350	1344	800	1003	1405	1400
	2D	1015	982	685	685	770	768
CHLORIDE	2A	1009	759	731	640	805	659
	2B	1560	922	1098	988	1019	1057
	2C	1791	2145	1922	1654	1538	1779
	2D	2943	1524	1121	777	939	906
SULFATE	2A	474	432	410	190	557	525
	2B	796	666	790	590	780	675
	2C	1152	1182	1170	1132	922	1024
	2D	956	854	610	558	532	707
ORTHOPHOSPHATE	2A	49	40.6	28	31	27.7	30
	2B	10	10.8	7.6	8	6	7
	2C	12	7.5	7	8	8	11
	2D	59	29.2	32.6	36	33	30

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	11/05/74	11/19/74	12/03/74	12/17/74	1/14/75	1/28/75
CADMIUM							
	2A		≤ 0.096		.1597	0.0304	
	2B		≤ 0.096		.7130	0.0268	
	2C		≤ 0.096		.7540	0.0299	
	2D		≤ 0.096		.1771	0.0284	
SODIUM							
	2A	355	472	400	435	255	546.4
	2B	480	455	435	498	325	650
	2C	990	940	955	810	555	1189
	2D	550	660	410	305	215	468
POTASSIUM							
	2A	620	630	608	593	600	615
	2B	915	611	865	853	860	900
	2C	1390	824	1500	1340	1170	1475
	2D	800	1400	593	500	470	520
CHLORIDE							
	2A	791	766	621	623	510	643
	2B	937	988	846	824	717	717
	2C	1771	1565	1796	1590	1020	1406
	2D	1032	1126	659	563	477	600
SULFATE							
	2A	250	442	465	494	420	454
	2B	485	505	590	765	660	606
	2C	1025	1120	1051	1050	1025	1200
	2D	625	705	510	535	425	530
ORTHOPHOSPHATE							
	2A	26.3	26.4	27.2	28	24	28
	2B	4.4	6.0	5.0	8.1	5.7	5.2
	2C	4	6.6	6.8	9.1	6.0	7
	2D	24.3	22.3	26.3	34	31.3	37.1

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	2/11/75	2/25/75	3/11/75	3/25/75	4/08/75	4/22/75
CADMIUM							
	2A	.026		0.012		1.45	
	2B	.032		0.058		1.12	
	2C	.020		0.018		2.67	
	2D	.014		0.020		1.47	
SODIUM							
	2A	465	455	435	355	430	390
	2B	495	560	525	445	505	515
	2C	910	405	770	340	850	750
	2D	460	330	390	255	507	500
POTASSIUM							
	2A	630	588	580	450	455	476
	2B	850	770	863	780	800	725
	2C	1425	487	963	525	800	842
	2D	635	380	523	385	465	556
CHLORIDE							
	2A	550	430	559	401	380	696
	2B	727	654	765	511	424	928
	2C	1195	443	948	413	431	885
	2D	555	348	580	325	213	1002
SULFATE							
	2A	505	422	540	414	316	372
	2B	710	646	644	602	365	560
	2C	1140	356	812	474	699	666
	2D	565	326	562	362	438	711
ORTHOPHOSPHATE							
	2A	25	23.1	24.6	41	35.8	43.3
	2B	3.8	5.9	8.1	16.5	15	23.3
	2C	6.0	4.9	6.2	12	3.50	14.3
	2D	32.6	27.4	27.2	17.9	17.1	33.0

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	5/06/75	5/20/75	6/03/75	6/17/75	7/01/75	7/15/75
CADMIUM							
	2A	0.031			0.010		
	2B	0.034			0.016		
	2C	0.035			0.023		
	2D	0.029			0.029		
SODIUM							
	2A	365	301	315	347	305	265
	2B	450	319	380	385	360	355
	2C	615	575	640	518	425	425
	2D	410	359	435	318	332	410
POTASSIUM							
	2A	442.5	389	510	410	362	320
	2B	650	695	725	529	464	483
	2C	750	970	1100	700	765	590
	2D	465	600	650	337	450	458
CHLORIDE							
	2A	501	628		687	737	759
	2B	864	948	885	1170	1011	1286
	2C	717	1602	1159	738	1446	906
	2D	480.5	1054	1096		893	1265
SULFATE							
	2A	138	300	406	262	240	290
	2B	464	586	456	290	406	450
	2C	628	760	748	531	522	484
	2D	350	520	476		410	544
ORTHOPHOSPHATE							
	2A	40.1	44.0	44.5	46.3	46.8	48.0
	2B	17.3	17.3	16.8	25.5	34.3	29.1
	2C	10.8	11.3	12.3	9.8	26.8	16.3
	2D	23.7	30.0	23.8		28.6	32.3

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	7/29/75	8/12/75	8/26/75	9/09/75	9/23/75	10/07/75
CADMIUM							
	2A		0.004	0.0025	.0023	.0050	
	2B		0.015	0.048	.0037	.0019	
	2C		0.004	0.0069	.0049	.0019	
	2D		0.005	0.0043	.0033	.016	
SODIUM							
	2A	244	270	262	260	405	
	2B	339	340	335	333		
	2C	440	514	500	533		
	2D	450	490	300	450		
POTASSIUM							
	2A	324	319	293	325	315	
	2B		400	450	450	445	
	2C	600	680	503	625	1050	
	2D	500	505	250	475	452	
CHLORIDE							
	2A	898	1453	1524	1793	230	506
	2B	1210	1651	1738	2450	354	506
	2C	1095	1519	1812	2505	656	528
	2D	1656	2449	2491	2600	300	320
SULFATE							
	2A	332	300	316	302		
	2B	486	512	465	460		
	2C	656	722	606	720		
	2D	456	670	406	466		
ORTHOPHOSPHATE							
	2A	46.3	44.8	42.8	28.6	44.1	19.6
	2B	23.8	23.8	19.3	19.2	18.1	7.0
	2C	16.8	15.8	11.8	13.3	13.7	5.6
	2D	30.6	29.0	24.8	25.1	25.6	11.6

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	10/21/75	11/04/75	11/18/75	12/02/75	12/16/75	1/02/76
CADMIUM							
	2A	.0035		.0054		.0032	
	2B	.003		.0125		.0038	
	2C	.0045		.0058		.0064	
	2D	.0045		.0035		.0049	
SODIUM							
	2A	255	255	470	291	285	264
	2B	300	272	200	293	250	220
	2C	365	720	480	575	505	435
	2D	198	305	285	387	360	220
POTASSIUM							
	2A	326	319	376	351	342	322.5
	2B	414	394	340	436	275	443.5
	2C	502	135	715	890	725	650
	2D	201	334	360	459	299	337.5
CHLORIDE							
	2A	595	382	176	248	330	84
	2B	435	472	212	337	384	190
	2C	752	1147	499	1186	911	520
	2D	320	642	286	557	473	105
SULFATE							
	2A	310	264	291	308	219	265
	2B	394	412	380	333	268	409
	2C	538	782	744	657	505	662
	2D	126		301	271	289	157
ORTHOPHOSPHATE							
	2A	39.3	4.9	29.8	46	38	35.9
	2B	16.0	15.8	17.1	20	15.8	13.0
	2C	9.1	10.9	12.4	11	12.0	22.3
	2D	15.0	24.9	14.4	22	21.7	18.7

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	2/03/76	2/17/76	3/02/76	3/16/76	3/30/76	4/13/76
CADMIUM							
	2A		0.0141	0.0088	0.0036	0.0090	0.0093
	2B		0.0030	0.0193	0.0040	0.0053	0.0077
	2C		0.0034	0.0106	0.0045	0.0062	0.0084
	2D		0.0056	0.0149	0.0045	0.0021	0.0115
SODIUM							
	2A	271.5					
	2B	325					
	2C	435					
	2D	276					
POTASSIUM							
	2A	326.5					
	2B	446.5					
	2C	695					
	2D	296.5					
CHLORIDE							
	2A	198					
	2B	514					
	2C	832					
	2D	408					
SULFATE							
	2A	257					
	2B	347					
	2C	581					
	2D	206					
ORTHOPHOSPHATE							
	2A	46.1					
	2B	27.9					
	2C	49.9					
	2D	22.3					

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	4/27/76	5/11/76	5/25/76	6/08/76	6/23/76	7/06/76
CADMIUM							
	2A	0.0142	0.0046	0.002	0.006	0.004	0.0016
	2B	0.0189	0.0089	0.002	0.006	0.005	0.0055
	2C	0.0237	0.0136	0.006	0.003	0.007	0.0031
	2D	0.0128	0.0046	0.004	0.008	0.006	0.0087
SODIUM							
	2A	264					
	2B	268					
	2C	470					
	2D	365					
POTASSIUM							
	2A	330					
	2B	373					
	2C	650					
	2D	395					
CHLORIDE							
	2A	741					
	2B	479					
	2C						
	2D	536					
SULFATE							
	2A	250					
	2B	274					
	2C	638					
	2D	316					
ORTHOPHOSPHATE							
	2A	36.9					
	2B	17.5					
	2C	10.2					
	2D	20.1					

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	7/20/76	8/03/76	8/17/76	8/31/76	9/14/76	9/28/76
CADMIUM							
	2A	.0056	.007	.0098	.0081	.005	.0093
	2B	.0048	.0068	.0072	.004	.005	.0052
	2C	.0057	.0136	.0077	.171	.009	.0055
	2D	.006	.0137	.0166	.0042	.006	.0135
SODIUM							
	2A		224				
	2B		262				
	2C		445				
	2D		274				
POTASSIUM							
	2A		300				
	2B		365				
	2C		625				
	2D		300				
CHLORIDE							
	2A		150				
	2B		251				
	2C		572				
	2D		234				
SULFATE							
	2A	232	256	52	151	1.5	198
	2B	296	261	207	135	1.07	202
	2C	602	544	501	498	53	348
	2D	196	53	9	142	2	96
ORTHOPHOSPHATE							
	2A		14	13.9	42.3	38.5	37.4
	2B		7.4	7.1	22.6	23.2	19.1
	2C		5.2	5.1	15.7	16.2	7.5
	2D		6.5	6.5	18.8	16.5	14.

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	10/12/76	10/26/76	11/09/76	11/23/76	12/07/76
CADMIUM						
	2A	.0238	.0039	.0049	.0056	.0008
	2B	.0154	.0034	.0036	.0060	.0010
	2C	.0086	.0052	.0036	.0089	.0027
	2D	.0274	.0034	.0078	.0072	.0040
SODIUM						
	2A				162	
	2B				211	
	2C				319	
	2D				270	
POTASSIUM						
	2A				160	
	2B				272	
	2C				466	
	2D				234	
CHLORIDE						
	2A				238	
	2B				344	
	2C				494	
	2D				446	
SULFATE						
	2A	179	126	236	228	116
	2B	186	141	238	236	118
	2C	364	116	384	573	225
	2D	163	94	605	260	101
ORTHOPHOSPHATE						
	2A	30	46	60	43	48.4
	2B	27.4	30	45.7	34	31.7
	2C	13.7	31	37.2	30.6	28.1
	2D	16	27	26.3	25	20.7

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	9/25/72	10/02/72	10/10/72	10/24/72	11/07/72	11/20/72
TOTAL PHOSPHATE							
	2A						
	2B						
	2C						
	2D	11.4	6.5	4.2	3.8		
AMMONIA-N							
	2A						
	2B						
	2C						
	2D	73	107	112	132	123	150
KJELDAHL-N							
	2A						
	2B						
	2C						
	2D	81	43	24	22	26	26
NITRATE-N							
	2A						
	2B						
	2C						
	2D	0.73	0.85				
NITRITE-N							
	2A						
	2B						
	2C						
	2D						
COD							
	2A						
	2B						
	2C						
	2D	4594	4541	4702	5190	5869	7758
BOD							
	2A						
	2B						
	2C						
	2D						

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	12/05/72	12/18/72	1/02/73	1/16/73	1/30/73	2/13/73
TOTAL PHOSPHATE							
	2A						
	2B						
	2C						
	2D	2.0				3.8	
AMMONIA-N							
	2A						
	2B						
	2C						
	2D	100	92	121	201	342	371
KJELDAHL-N							
	2A						
	2B						
	2C						
	2D	20	29	26	87	58	72
NITRATE-N							
	2A						
	2B						
	2C						
	2D						
NITRITE-N							
	2A						
	2B						
	2C						
	2D						
COD							
	2A						
	2B						
	2C						
	2D	7582	5872	5796	10840	15280	15440
BOD							
	2A						
	2B						
	2C						
	2D			3294			

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	2/27/73	3/13/73	3/27/73	4/24/73	5/08/73	5/22/73
TOTAL PHOSPHATE							
	2A						
	2B				101		
	2C						
	2D	5.2			18.5		
AMMONIA-N							
	2A						
	2B	791	798	862	754	906	
	2C						
	2D	345	410	302	55	344	424
KJELDAHL-N							
	2A						
	2B	421	432		657	584	
	2C						
	2D	68	88	81	353	61	532
NITRATE-N							
	2A						
	2B						
	2C						
	2D						
NITRITE-N							
	2A						
	2B						
	2C						
	2D						
COD							
	2A						
	2B	37090	43585	47226	61600	56500	
	2C						
	2D	15000	17320	13356	17000	16100	19500
BOD							
	2A						
	2B		1645			15000	
	2C						
	2D		5750			48000	

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	6/05/73	6/19/73	7/03/73	7/17/73	7/31/73	8/14/73
TOTAL PHOSPHATE							
	2A				95	39.8	42
	2B					135	64
	2C					44	37
	2D					43	
AMMONIA-N							
	2A	399	648	664	775	794	875
	2B	573	812	836	861	873	922
	2C		1071	559	689	755	845
	2D	475	599	557	723	710	773
KJELDAHL-N							
	2A	453	1325	1256	1544	1560	1501
	2B	370	1458	1403	1376	1620	1467
	2C		160	941	1281	1429	1455
	2D	105	866	752	1058	990	1033
NITRATE-N							
	2A						
	2B						
	2C						
	2D						
NITRITE-N							
	2A						
	2B						
	2C						
	2D						
COD							
	2A	32150	51375	48503	56635	57370	56331
	2B	40600	53100	50362	56635	57370	58247
	2C		21378	42757	49018	54538	56331
	2D	22525	30171	28560	33782	32011	33722
BOD							
	2A						
	2B						
	2C						
	2D						

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	8/28/73	9/11/73	9/25/73	10/09/73	10/23/73	11/07/73
TOTAL PHOSPHATE							
	2A	42	28				
	2B	1800	42				
	2C	36	27			20	
	2D	35	36				
AMMONIA-N							
	2A	870	877	839	810	936	1035
	2B	920	948	972	1001	1185	857
	2C	845	744	803	870	977	960
	2D	850	856	872	703	945	935
KJELDAHL-N							
	2A	1470	1404	1348	1281	1456	1262
	2B	1608	1568	1550	1523	1897	1696
	2C	1478	1425	1333	1371	1673	1619
	2D	1086	1150	1172	912	1242	1225
NITRATE-N							
	2A						
	2B						
	2C						
	2D						
NITRITE-N							
	2A						
	2B						
	2C						
	2D						
COD							
	2A	53670	51480	48726	48891	41722	40608
	2B	55508	55380	55158	56243	59040	60352
	2C	69477	55380	53256	56610	56285	59598
	2D	36660		37279	33819	36605	41869
BOD							
	2A						
	2B						
	2C						
	2D						

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	11/20/73	12/04/73	12/18/73	1/15/74	1/29/74	2/12/74
TOTAL PHOSPHATE							
	2A						
	2B						
	2C						
	2D						
AMMONIA-N							
	2A	843	821	805	762	728	671
	2B	1043	1025	1011	983	1045	949
	2C	1054	965		888	870	951
	2D	947	830	896	736	687	782
KJELDAHL-N							
	2A	1243	1192	1160	1060	1030	983
	2B	1671	1619	1600	1496	1634	1588
	2C	1790	1654		1451	1455	1690
	2D	1214	1050	1135	1005	925	1040
NITRATE-N							
	2A						
	2B						
	2C						
	2D						
NITRITE-N							
	2A						
	2B						
	2C						
	2D						
COD							
	2A	45050	43560	41171	40795	38805	38232
	2B	56610	55440	52934	51384	55020	53644
	2C	61022	57960		54683	51317	60760
	2D	41171	34740	37863	36456	32395	38164
BOD							
	2A		24150		25760		17250
	2B		31970		37720		30590
	2C		28520		33120		29440
	2D		28980		20240		29840

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	2/26/74	3/12/74	3/26/74	4/09/74	4/23/74	5/07/74
TOTAL PHOSPHATE							
	2A						
	2B						
	2C						
	2D						
AMMONIA-N							
	2A	655	656	632	608	641	610
	2B	1006	1012	976	938	966	921
	2C	992	984	986	897	812	910
	2D	874	827	662	535	681	760
KJELDAHL-N							
	2A	960	961	910	930	894	842
	2B	1593	1512	1480	1422	1380	1331
	2C	1790	1702	1689	1517	1329	1490
	2D	1226	1107	889	744	917	1011
NITRATE-N							
	2A						
	2B						
	2C						
	2D						
NITRITE-N							
	2A						
	2B						
	2C						
	2D						
COD							
	2A	34500	35094	36612	33352	33660	32688
	2B	53432	52021	52332	46280	46286	45380
	2C	59536	61907	64120	51716	46914	51856
	2D	37928	37574	31468	25648	30241	31604
BOD							
	2A		23460		25760		23000
	2B		35420		37260		33580
	2C		34960				40480
	2D		32200		34730		23000

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	5/21/74	6/04/74	6/18/74	7/02/74	7/16/74	7/30/74
TOTAL PHOSPHATE							
	2A						
	2B						
	2C						
	2D						
AMMONIA-N							
	2A	587	579	589	546	511	497
	2B	880	867	851	868	775	767
	2C	907	883	907	718	782	806
	2D	820	804	877	590	571	692
KJELDAHL-N							
	2A	832	815	796	783	722	659
	2B	1249	1251	1079	1075	1065	1053
	2C	1534	1432	1537	1170	1259	858
	2D	1098	1046	1074	893	730	858
NITRATE-N							
	2A						
	2B						
	2C						
	2D						
NITRITE-N							
	2A						
	2B						
	2C						
	2D						
COD							
	2A	33269	32619	31940	31164	29288	28508
	2B	44735	45786	42854	45215	39496	39814
	2C	55037	54081	54607	43223	46736	48215
	2D	37574	38112	39877	28766	28436	33617
BOD							
	2A		23000		62560		29900
	2B		33580		72220		34500
	2C		36800		74980		43240
	2D		33580		79120		28520

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	8/13/74	8/27/74	9/10/74	9/24/74	10/08/74	10/22/74
TOTAL PHOSPHATE							
	2A			31			
	2B			10			
	2C	N.A.		17.9			
	2D			33			
AMMONIA-N							
	2A	470	482	441	458	460	475
	2B	756	741	668	704	700	705
	2C	825	871	841	911	912	937
	2D	777	784	539	538	617	599
KJELDAHL-N							
	2A	639	585	562	652	674	624
	2B	1025	978	752	955	870	902
	2C	1330	1346	1414	1430	1467	1408
	2D	1046	1013	728	697	801	733
NITRATE-N							
	2A			12.3	25		33.83
	2B			28.3	18		2.66
	2C	N.A.		48	183		26.7
	2D			11	13		20
NITRITE-N							
	2A			0.075	0.238		0.14
	2B			0.05	0.070		0.09
	2C			0.076	0.230		0.154
	2D			0.06	0.055		0.11
COD							
	2A	27334	27036	26410	27764	27727	27984
	2B	38875	36902	36680	36744	35887	35476
	2C	48988	50618	52086	52128	52612	54348
	2D	36054	35487	26520	26064	29903	29792
BOD							
	2A		50600	36340	25300		17940
	2B		52900	41860	29140		22080
	2C	N.A.	58420	51980	29440		36800
	2D		60260	36800	15640		28520

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	11/05/74	11/19/74	12/03/74	12/17/74	1/14/75	1/28/75
TOTAL PHOSPHATE	2A				28		
	2B				9.6		
	2C				21.6		
	2D				34		
AMMONIA-N	2A	458	466	433	462	486	458
	2B	692	689	675	678	741	738
	2C	930	912	970	909	809	971
	2D	641	694	495	403	434	446
KJELDAHL-N	2A	604	596	603	590	641	607
	2B	917	920	901	894	954	947
	2C	1434	1446	1461	1411	1203	1425
	2D	798	905	579	1411	455	554
NITRATE-N	2A		28.13		1.50	9.0	
	2B		25.2		9.50	16.68	
	2C		181.3		13.50	18.65	
	2D		32.4		5.0	7.43	
NITRITE-N	2A		0.005		28	0.028	
	2B		0.0045		0.045	0.034	
	2C		0.020		0.027	0.069	
	2D		0.004		0.027	0.021	
COD	2A	27230	26668	26714	28656	27086	28694
	2B	34860	32973	33744	36072	35467	36483
	2C	54285	53175	54131	53856	46888	54041
	2D	31885	33247	23199	23040	20797	21847
BOD	2A		11040		14720	15410	
	2B		17020		20010	20010	
	2C		31280			28750	
	2D		23920		23000	24840	

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	2/11/75	2/25/75	3/11/75	3/25/75	4/08/75	4/22/75
TOTAL PHOSPHATE							
	2A			24.7			
	2B			8.1			
	2C			9.5			
	2D			26.4			
AMMONIA-N							
	2A	515	432	455	345	346	321
	2B	742	687	729	625	578	468
	2C	929	307	668	373	526	543
	2D	470	261	393	251	380	423
KJELDAHL-N							
	2A	614	576	611	495	447	415
	2B	969	893	955	787	772	739
	2C	1437	482	1048	567	693	830
	2D	601	381	511	304	541	551
NITRATE-N							
	2A	4		147		9.9	
	2B	1.9		11.4		12.8	
	2C	16.58		10.7		18.7	
	2D	6		6.4		9.9	
NITRITE-N							
	2A	.005		.007		.053	
	2B	.003		.011		.068	
	2C	.006		.028		.108	
	2D	.004		.016		.228	
COD							
	2A	25245	23550	27342	25168	22681	23500
	2B	32736	31824	35601	32936	29409	31207
	2C	48444	16099		22948	38114	33621
	2D	21450	16287	21576	15179	18485	23330
BOD							
	2A	19550		19090		26312	
	2B	24150		26680			32591
	2C	32660		27600		40480	
	2D	26330		28290		39560	

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	5/06/75	5/20/75	6/03/75	6/17/75	7/01/75	7/15/75
TOTAL PHOSPHATE							
	2A				62.6		
	2B				35.0		
	2C				19.1		
	2D				32.6		
AMMONIA-N							
	2A	314	268	306	297	244	228
	2B	509.5	518	466	436	392	412
	2C	545.5	587	589	436	362	394
	2D	351	341	352	232	261	340
KJELDAHL-N							
	2A	434	350	434	398	365	348
	2B	664	658	639	565	504	654
	2C	711	858	866	691	514	605
	2D	408	462	434	276	305	412
NITRATE-N							
	2A	13.75	9.10	11.6	7.3	5.7	9.8
	2B	19	11.5	11.3	6.2	4.1	11.9
	2C	27	23.4	22.0	9.9	7.5	9.3
	2D	9.25	11.8	7.9	3.6	2.9	10.1
NITRITE-N							
	2A	0.021	0.021	.020	62.6	0.020	0.018
	2B	0.020	0.013	.017	35.0	0.018	0.028
	2C	0.0235	0.035	.026	19.6	0.023	0.013
	2D	0.050	0.058	.041	32.6	0.023	0.033
COD							
	2A	20444	20992	23134	25818	22401	22491
	2B	28037.5	26823	27864	34437	25713	26951
	2C	31199	35153	35543	34040	28635	27065
	2D	18039	20692	18792	40514	17142	18449
BOD							
	2A	38980			28600	15833	27250
	2B	36065			34850	26750	31100
	2C	36055			42850	39000	53950
	2D	37355			44200	19250	26250

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	7/29/75	8/12/75	8/26/75	9/09/75	9/23/75	10/07/75
TOTAL PHOSPHATE							
	2A					43.5	
	2B					20.0	
	2C					18.5	
	2D					26.5	
AMMONIA-N							
	2A	206	204	236	238	283	670
	2B	363	395	397	387	426	398
	2C	413	487	516	532	600	600
	2D	383	402	341	379	396	392
KJELDAHL-N							
	2A	279	286	294	401	344	376
	2B	532	470	546	869	430	492
	2C	627	660	710	818	806	835
	2D	488	474	410	486	469	501
NITRATE-N							
	2A	3.5	4.75	2.8	2.2	12.0	
	2B	3.7	7.75	4.2	3.3	8.0	
	2C	5.5	10.40	4.9	8.7	3.0	3.33
	2D	6.0	7.6	3.9	7.5	9.0	2.78
NITRITE-N							
	2A	0.015	0.010	0.010	0.006	0.024	
	2B	0.018	0.008	0.008	0.017	0.030	
	2C	0.025	0.012	0.005	0.010	0.046	
	2D	0.033	0.018	0.013	0.009	0.034	
COD							
	2A	12732	18870	17344	17131	9752	21785
	2B	24660	21450	23061	21674	10752	25682
	2C	23719	28118	29882	31356	22360	32294
	2D	23718	20740	16890	26722	28326	23177
BOD							
	2A	N.V.	27500	19800	18051	30333	19250
	2B	N.V.	29400	28400	20394	32274	22250
	2C	N.V.	31050	26600	27192	36960	27250
	2D	N.V.	36900	22550	27489	40722	28750

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	10/21/75	11/04/75	11/18/75	12/02/75	12/16/75	1/02/76
TOTAL PHOSPHATE							
	2A						
	2B						
	2C						
	2D						
AMMONIA-N							
	2A	230	205	259	271	224	266
	2B	381	346	340	375	338	417.1
	2C	369	611	612	660	522	576.7
	2D	87.4	258	355	371	344	231.6
KJELDAHL-N							
	2A	248	336	336	342	322	306.5
	2B	453	434	422	433	431	508.6
	2C	529	819	855	863	713	787.4
	2D	113	327	524	416	394	305.4
NITRATE-N							
	2A	4.30	.095	.79	6.22	4.73*	4.10*
* Plus Nitrite-N	2B	2.70	0.3	2.31	5.45	4.86*	6.70*
	2C	3.50	0.3	.44	5.43	4.04*	11.30*
	2D	7.20	0.5	1.55	3.88	2.40*	3.60*
NITRITE-N							
	2A						
	2B		0.3				
	2C		0.3				
	2D						
COD							
	2A	19150	18126	18390	18139	17578	17677
	2B	20683	19426	19347	20016	20092	23307
	2C	31020	25950	35649	34843	30796	34522
	2D	5948	34833	26764	24594	21804	14431
BOD							
	2A	25750		34000		26750	29750
	2B	29500		44000		29750	29750
	2C	31750		26500		48250	38250
	2D	24000		41750		31750	26000

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	2/03/76	2/17/76	3/02/76	3/16/76	3/30/76	4/13/76
TOTAL PHOSPHATE							
	2A						
	2B						
	2C						
	2D						
AMMONIA-N							
	2A	295					
	2B	424					
	2C	582					
	2D	257					
KJELDAHL-N							
	2A	317.1	348	390.4	379	386	385
	2B	504.4	500	528.1	510	495	508
	2C	815	844	790.7	843	857	891
	2D	518.2	368	315.7	805	409	450
NITRATE-N							
	2A	.53*					
* Plus Nitrite-N	2B	1.10*					
	2C	2.40*					
	2D	2.05*					
NITRITE-N							
	2A						
	2B						
	2C						
	2D						
COD							
	2A	21915	21166	20875	21695	19897	19758
	2B	24189	24762	22795	23508	21420	21663
	2C	34746	38677	31121	37209	37128	36987
	2D	15208	19241	9059	16473	16565	34752
BOD							
	2A						
	2B						
	2C						
	2D						

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	4/27/76	5/11/76	5/25/76	6/08/76	6/23/76	7/06/76
TOTAL PHOSPHATE							
	2A	37.0					
	2B	16.7					
	2C	13.8					
	2D	19.3					
AMMONIA-N							
	2A	318					
	2B	441					
	2C	670					
	2D	397					
KJELDAHL-N							
	2A	394	167	392	382	242	366.4
	2B	476	206	466	495	502	468.8
	2C	910	896	730	564	678	246.0
	2D	469	474	339	332	324	221.3
NITRATE-N							
	2A	2.4*					
* Plus Nitrite-N	2B	3.7*					
	2C	N.A.					
	2D	2.2*					
NITRITE-N							
	2A						
	2B						
	2C						
	2D						
COD							
	2A	23051	19236	20504	18192	21902	19701
	2B	23585	21341	22391	20697	23676	21312
	2C	39872	37610	36360	26200	29988	28903
	2D	21360	21925	17964	14208	16863	13338
BOD							
	2A	2000					
	2B	> 10000					
	2C	8000					
	2D	> 10000					

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	7/20/76	8/03/76	8/17/76	8/31/76	9/14/76	9/28/76
TOTAL PHOSPHATE							
	2A			12.9			
	2B		7.0				
	2C		5.2				
	2D		6.0				
AMMONIA-N							
	2A	320	271	289	272	289	298
	2B	439	398	373	380	380	372
	2C		560	554	566	588	412
	2D	301	284	324	370	324	212
KJELDAHL-N							
	2A	406	358	360	346	329	369
	2B	526	455	394	449	384	392
	2C	708	728	732	774	790	522
	2D	356	321	380	397	370	244
NITRATE-N							
	2A		4.15*				
*Plus Nitrite-N	2B		2.36*				
	2C		2.90*				
	2D		7.25*				
NITRITE-N							
	2A						
	2B						
	2C						
	2D						
COD							
	2A	18654	21315	22402	25533	23357	17617
	2B	20542	32534	21402	31304	22741	20619
	2C	30520	31972	30493	34124	33578	23226
	2D	16586	24017	18792	20769	19868	15484
BOD							
	2A		10000				
	2B		8000				
	2C		8650	8104			
	2D		16000				

LEACHATE SAMPLE CONCENTRATIONS

	TEST CELL	10/12/76	10/26/76	11/09/76	11/23/76	12/07/76
TOTAL PHOSPHATE						
	2A				45.6	
	2B				32.5	
	2C				31.2	
	2D				21.6	
AMMONIA-N						
	2A	262	288	261	272	300
	2B	354	404	354	382	384
	2C	432	425	390	454	490
	2D	272	271	556	326	348
KJELDAHL-N						
	2A	363	376	356	357	363
	2B	432	473	448	459	486
	2C	584	496	529	573	640
	2D	332	310	307	372	409
NITRATE-N						
	2A				2.22*	
* Plus Nitrite-N	2B				1.12*	
	2C				1.20*	
	2D				0.98*	
NITRITE-N						
	2A					
	2B					
	2C					
	2D					
COD						
	2A	20570	22192	25320	21925	22229
	2B	20300	23180	33840	23345	23208
	2C	27560	23674	28400	30525	31563
	2D	18400	16598	35940	21260	21477
BOD						
	2A				17000	
	2B				16000	
	2C				17750	
	2D				18000	

APPENDIX D

GAS DATA - TEST CELLS 2 - METHANE (CH_4)[a]

Sample Date	Probe Location									
	A1c	B1c	C1c	D1b	D1d	D4b	D4d	A7c	B7c	C7c
8-28-72	0.20	0.20	0.02	0.02	0.08	0.04	0.04		0.01	0.03
9-11-72	0.20	0.00	0.01	0.06	0.14	0.09			0.04	0.02
9-18-72	0.01	0.04	0.01	0.07	0.08	0.09			0.05	0.01
9-25-72	0.01	0.07	0.01	0.07	0.08	0.09			0.07	0.03
10-2-72	0.01		0.02	0.06	0.11	0.08			0.09	0.01
10-10-72	0.01	0.18	0.01	0.06	0.14	0.09			0.14	0.01
10-16-72	0.01	0.18	0.01	0.07	0.16	0.10			0.16	0.01
10-24-72	0.01	0.20	0.01	0.07	0.08	0.09	0.07		0.18	0.01
11-7-72			0.01	0.11	0.09	0.11			0.17	0.01
11-21-72	0.01	0.10	0.01	0.15	0.14	0.13			0.13	0.02
12-4-72	0.01		0.01	0.18	0.13	0.13	0.01		0.12	0.01
12-13-72	0.01		0.01	0.14	0.08				0.09	0.01
1-2-73	0.01		0.01	0.13	0.06	0.09			0.08	0.01
1-16-73		0.02	0.01	0.12	0.17	0.08			0.08	0.01
1-30-73			0.01	0.18		0.11				0.01
2-13-73	0.01	0.04	0.01	0.20		0.13			0.07	0.01
2-27-73	0.01	0.01	0.01	0.19	0.18	0.15			0.07	0.07
3-13-73	0.01	0.02	0.01	0.25	0.16	0.19			0.09	0.01
3-27-73	0.01	0.03	0.01	0.29	0.12	0.20			0.12	0.01
4-10-73			0.10		0.29	0.25				0.01
4-24-73	0.01	0.01	0.01		0.18	0.25			0.22	0.01
5-8-73		0.01	0.02		0.25	0.25			0.29	0.01
5-22-73	0.01	0.01	0.01	0.60	0.17	0.33			0.10	0.01
6-5-73	0.01	0.01	0.01	0.83	0.26	0.40			0.08	0.01
6-5-73 to 10-15-73	No Gas Samples Taken									

[a] All values in % by volume

GAS DATA - TEST CELLS 2 - METHANE (CH_4)[a].

Sample Date	Probe Location									
	A1c	B1c	C1c	D1b	D1d	D4b	D4d	A7c	B7c	C7c
11-13-73			1.1	2.7	17.3	5.2	18.0	0.1	0.9	0.3
12-10-73								0.0		
1-14-74								0.0		0.0
2-4-74							-	-		
3-4-74		0.4	0.0			6.3	-	-	0.0	0.5
4-8-74		0.0		1.6			-	-	0.0	1.1
4-29-74		0.0	0.0	4.3			-	-	0.0	0.0
7-2-74		0.0		0.0			-	-	0.0	0.0
8-6-74		0.74	0.04				-	-	0.0	0.0
9-2-74	-	0.6	0.0		26.9	10.0	-	-		
10-1-74			4.6		49.5	22.3	-	-		0.0
11-11-74				11.7			-	-		0.0
12-11-74			0.43				-	-	0.73	0.0
1-21-75							15.8		0.0	
4-15-75	1.7	2.4	1.2	-	5.2	8.8	4.1	-	1.5	1.1
5-11-75	3.1	-	-	0.0	14.6	11.8	14.3	-	1.4	-
6-9-75	3.8	0.5	2.9	0.0	25.4	8.2	22.9	-	-	-
7-8-75	7.0	0.7	2.3	0.0	30.5	0.0	28.7	-	0.4	-
11-10-75	-	2.1	14.7	-	45.5	36.9	41.5	-	5.3	9.7
2-9-10-76	0.0	1.1	3.5	-	10.6	0.0	9.6	-	2.5	5.3
4-11-76										
7-12-76		2.5	2.6	-	28.2	6.6	34.0	-	2.5	2.4
9-21-76	-	3.9	5.6	-	47.2	29.4	45.9	-	4.5	3.8
11-16-76	-	4.2	2.9	-	27.5	13.4	21.9	-	6.4	3.8

a. All values in % by volume

GAS DATA - TEST CELLS 2 - CARBON DIOXIDE (CO_2)[a].

Sample Date	Probe Location									
	A1c	B1c	C1c	D1b	D1d	D4b	D4d	A7c	B7c	C7c
8-28-72	26.91	17.30	1.00	32.81	35.50	33.27	30.40		28.12	33.92
9-11-72	29.79	17.07	31.87	36.29	37.02	38.09			26.40	37.87
9-18-72	28.79	18.98	30.14	36.30	32.02	38.94			28.66	39.75
9-25-72	30.97	24.64	32.94	36.53	32.90	39.35			29.82	39.98
10-2-72	46.16			39.49	40.34	37.79			33.93	39.96
10-10-72	52.21	46.64	53.50	49.00	47.33	48.05			41.63	38.80
10-16-72	54.80	48.31	53.61	53.92	49.85	51.07			44.76	47.78
10-24-72	51.98	43.64	57.58	54.31	54.94	54.86	44.34		47.37	51.42
11-7-72			48.39	54.04	53.05	54.44			48.45	54.57
11-21-72	29.99	33.26	49.10	57.70	60.68	57.21			52.44	45.16
12-4-72	35.31		48.65	61.85	45.62	62.20	38.46		54.92	56.10
12-18-72	33.55		51.48	61.89	49.20				58.03	54.03
1-2-73	35.66		48.80	67.97	40.62	66.15			61.0	59.25
1-16-73		39.85	51.70	70.96	49.51	68.04			62.80	61.17
1-30-73				68.49		66.06				
2-13-73	35.61	34.36	28.88	66.89		62.97			62.75	47.84
2-27-73	35.35	33.02	32.97	68.08	43.97	63.43			63.46	53.86
3-13-73	36.22	38.78	38.57	67.52	45.77	62.88			62.33	51.51
3-27-73	29.89	37.19	35.87	67.24	50.63	60.72			62.92	54.55
4-10-73			35.75		54.97	63.52				55.97
4-24-73	36.18	40.66	47.69		54.68	65.33			62.65	56.08
5-8-73		40.36	43.66		59.61	54.43			62.12	56.72
5-22-73	10.66	25.57	28.17	63.35	59.20	68.32	–	–	53.00	54.30
6-6-73	20.13	33.87	39.88	57.54	63.74	69.92	–	–	52.63	55.48
6-10 to 10-15-73	No Gas Samples Taken									

[a] All values in % by volume

GAS DATA - TEST CELLS 2 - CARBON DIOXIDE (CO_2)[a]

Sample Date	Probe Location									
	A1c	B1c	C1c	D1b	D1d	D4b	D4d	A7c	B7c	C7c
10-15-73			33.6		37.6		42.0		65.7	
11-13-73			69.1	54.9	75.9	70.4	72.8		83.8	77.4
12-10-73										
1-14-74										65.5
2-4-74							-	-		
3-4-74		36.4	52.6			63.9	-	-	68.3	78.8
4-8-74		42.7		43.1			-	-	59.3	64.5
4-29-74		37.7	55.4	42.2			-	-	50.9	71.4
7-2-74		47.51	57.75				-	-	49.36	57.75
8-6-74		46.72	67.06				-	-	77.79	77.79
9-2-74	-	62.0	80.7		64.6	65.1	-	-		
10-1-74			58.7		41.2	50.8	-	-		67.4
11-11-74				49.1			-	-		70.4
12-11-74			68.42				-	-	53.31	71.33
1-21-75							23.7		0.5	
4-15-75	39.5	32.2	34.7	-	28.8	51.9	22.6	-	52.0	55.4
5-14-75	27.7	27.1	41.3	-	32.1	41.6	30.3	-	44.6	59.7
6-9-75	41.0	30.3	49.8	-	40.7	43.4	39.5	-	49.5	59.7
7-8-75	45.9	39.8	52.3	-	52.2	-	48.6	-	57.4	57.6
11-10-75	-	22.5	30.6	-	27.4	29.6	26.3	-	32.2	35.4
2-9-10-76	-	30.9	46.1	-	32.6	-	31.3	-	55.2	68.6
4-11-76										
7-12-76	-	34.4	50.0	-	45.0	23.7	44.3	-	29.7	54.9
9-21-76	-	35.1	51.9	-	43.0	38.3	40.9	-	43.0	47.7
11-16-76	-	35.4	44.3	-	37.6	26.7	33.6	-	46.2	53.3

a. All values in % by volume

GAS DATA - TEST CELLS 2 - OXYGEN $(O_2)^{a.}$

Sample Date	Probe Location									
	A1c	B1c	C1c	D1b	D1d	D4b	D4d	A7c	B7c	C7c
8-28-72	2.25	3.91	18.71	2.18	1.12	3.26	3.24		3.21	1.89
9-11-72	1.92	2.94	1.69	1.15	1.19	1.64			2.02	1.43
9-18-72	2.12	3.50	2.70	1.48	2.96	1.32			2.13	1.35
9-25-72	2.03	2.26	1.67	1.07	2.12	0.98			2.33	1.05
10-2-72	0.87		2.05	1.12	1.36	1.30			2.10	1.34
10-10-72	1.12	1.22	1.09	1.28	1.51	0.67			1.42	2.67
10-16-72	0.85	1.72	1.32	0.68	1.82	0.71			1.77	1.02
10-24-72	1.32	2.10	0.62	0.76	1.04	0.68			1.56	1.13
11-7-72			2.07	0.86	1.16	0.69			1.62	1.00
11-22-72	1.43	1.17	1.60	0.56	0.72	0.59			0.83	2.67
12-4-72	1.56		1.82	0.60	1.49	0.50			1.04	0.89
12-18-72	1.68		1.21	0.89	1.61				0.92	1.27
1-2-73	1.63		2.40	0.42	2.06	0.71			0.87	0.61
1-16-73		3.03	1.35	0.24	0.77	0.37			0.92	0.74
1-30-73			3.20	0.53		0.56				2.69
2-13-73	1.49	3.66	1.12	0.29		0.47			0.78	1.22
2-27-73	1.55	5.90	1.45	0.61		0.63			0.79	0.83
3-13-73	1.58	2.73	1.07	0.35		0.50			0.91	0.96
3-27-73	5.69	3.08	2.46	0.78		0.81			1.09	0.63
4-10-73			3.35		0.73	0.80				1.03
4-24-73	3.14	1.96	0.88		1.02	0.67			1.36	0.84
5-8-73		2.69	2.44		0.81	2.27			1.23	1.16
5-22-73	3.99	2.67	3.36	3.60	0.87	0.57	-	-	1.23	0.89
6-5-73	2.13	2.45	2.36	6.09	0.78	0.51	-	-	1.10	0.83
6-5-73 to 10-15-73	No Gas Samples Taken									

a. All values in % by volume

GAS DATA - TEST CELLS 2 - OXYGEN (O_2)[a]

Sample Date	Probe Location									
	A1c	B1c	C1c	D1b	D1d	D4b	D4d	A7c	B7c	C7c
10-15-73			1.7		3.2		1.3		3.8	
11-13-73			2.2	5.7	0.4	1.4	0.9		0.3	2.1
12-10-73										
1-14-74										2.0
2-4-74							-	-		
3-4-74		3.2	2.4			3.6	-	-	1.5	2.4
4-8-74		2.9		9.6			-	-	3.9	3.8
4-29-74		2.5	1.3	8.7			-	-	1.9	2.8
7-2-74		4.67	2.51				-	-	4.48	3.05
8-6-74		4.28	1.71				-	-	1.28	2.35
9-2-74	-	3.9	1.5		0.6	4.4	-	-		
10-1-74			0.5		1.1	0.7	-	-		3.5
11-11-74				13.7						2.8
12-11-74			2.04				-	-	4.89	4.32
1-21-75							5.0		3.4	
4-15-75	0.6	2.8	1.1	-	1.0	1.6	1.1	19.4	1.4	1.1
5-11-75	1.1	4.4	1.5	-	0.9	0.9	1.2	21.4	1.6	1.5
6-9-75	1.2	2.5	1.0	-	0.6	0.9	1.0	19.9	0.9	1.2
7-8-75	1.4	4.1	0.6	-	0.1	-	0.2	-	0.5	0.4
11-10-75	-	3.6	0.9	-	0.8	2.3	0.9	-	0.9	1.9
2-9-10-76	-	4.0	1.0	-	-	-	0.9	-	0.8	0.9
4-11-76					-					
7-12-76		3.4	1.0	-	0.4	10.8	0.4	-	2.6	1.5
9-21-76		2.5	0.5	-	-	2.0	0.1	-	0.9	0.4
11-16-76	-	1.7	0.6	-	0.4	9.3	0.5	-	0.5	1.2

a. All valu-s in % by volume

GAS DATA - TEST CELLS 2 - NITROGEN (N_2)a.

Sample Date	Probe Location									
	A1c	B1c	C1c	D1b	D1d	D4b	D4d	A7c	B7c	C7c
8-28-72	61.74	71.62	76.58	53.86	52.13	52.00	54.60	63.27	58.71	54.43
9-11-72	61.56	75.20	59.34	54.11	53.25	51.47			63.57	52.57
9-18-72	62.04	71.56	60.47	55.09	57.42	51.52			61.85	51.63
9-25-72	60.37	66.47	58.78	55.34	57.13	52.62			61.58	52.71
10-2-72	43.12		45.56	49.44	48.39	51.54			55.35	50.14
10-10-72	37.35	46.16	35.33	42.48	42.06	43.42			48.87	49.53
10-16-72	36.38	44.62	35.91	39.88	41.41	41.84			47.08	41.98
10-24-72	39.80	48.86	33.38	39.21	37.97	39.04	44.87		44.07	38.81
11-7-72			43.37	39.50	39.81	39.07			42.44	35.81
11-22-72	62.60	55.22	41.42	36.23	33.23	36.27			40.01	44.40
12-4-72	57.92		44.11	34.15	46.98	33.93	49.90		39.15	35.53
12-18-72	57.33		39.13	29.19	43.33				34.13	33.80
1-2-73	56.74		42.59	25.30	52.62	27.10			32.55	31.50
1-16-73		52.39	41.22	23.44	44.09	26.17			31.26	31.36
1-30-73			69.04	25.02		27.31				45.11
2-13-73	54.82	56.61	62.39	25.95		29.69			29.92	43.53
2-27-73	55.99	57.49	59.96	25.73	49.22	30.19			29.41	40.88
3-13-73	54.27	52.74	52.47	23.77	45.40	29.54			29.16	39.34
3-27-73	57.84	54.08	54.87	22.69	41.51	31.26			29.40	36.92
4-10-73			54.67		38.16	28.35				34.52
4-24-73	52.81	49.98	43.77		36.17	25.21			29.03	32.89
5-8-73		50.69	45.54		32.44	35.30			29.06	32.12
5-22-73	80.84	65.99	61.88	20.59	32.82	22.84	-	-	38.32	35.31
6-5-73	69.90	56.69	48.26	25.74	27.88	20.25	-	-	37.17	34.17
6-5-73 to 10-15-73	No Gas Samples Taken									

a. All values in % by volume

GAS DATA - TEST CELLS 2 - NITROGEN $(N_2)^{a.}$

Sample Date	Probe Location									
	A1c	B1c	C1c	D1b	D1d	D4b	D4d	A7c	B7c	C7c
10-15-73			10.6		13.9		6.9	77.5	27.0	
11-13-73			22.7	20.2	5.9	9.6	8.1	77.1	12.4	7.4
12-10-73								77.0		
1-14-74								75.4		15.0
2-4-74							-	-		
3-4-74		58.0	46.2			21.7	-	-	35.1	23.3
4-8-74		53.5		35.9			-	-	43.3	30.1
4-29-74		54.0	42.8	32.7			-	-	43.0	25.1
7-2-74		51.00	36.40				-	-	42.24	26.42
8-6-74		48.46	32.16				-	-	30.28	26.32
9-2-74	-	48.7	26.9		11.8	29.9	-	-		
10-1-74			25.2		8.8	11.5	-	-		23.3
11-11-74				25.5			-	-		24.7
12-11-74			28.37				-	-	43.40	30.16
1-21-75							56.5		44.2	
4-15-75	63.6	66.2	64.5	-	69.4	40.7	73.2	76.8	45.9	44.2
5-14-75	64.1	68.2	60.5	-	53.0	40.4	53.5	81.5	50.7	43.6
6-9-75	50.6	56.0	47.9	-	36.5	45.9	37.9	77.2	44.7	41.2
7-8-75	48.3	59.5	44.7	-	21.5	-	20.3	-	48.3	42.3
11-10-75	-	60.8	42.8	-	29.0	25.9	34.9	-	43.1	32.6
2-9-10-75	-	68.0	53.4	-	58.3	-	61.5	-	50.9	34.8
4-11-76										
7-12-76	-	64.0	51.0	-	22.4	59.0	24.3	-	70.4	44.9
9-21-76	-	54.4	37.4	-	8.7	27.0	10.6	-	44.6	31.1
11-16-76	-	56.9	49.4	-	35.2	46.4	46.1	-	44.4	34.9

a. All values in % by volume

APPENDIX E

MEAN MONTHLY TEST CELL TEMPERATURES[a]

Month	Probe Location								
	D1a	D1b	D1c	D1d	A1c	B1c	B1e	C1c	Z1
8-72	91.7	110.5	106.7	106.2	103.5	106.4	87.7	92.4	71.6
9-72	79.9	96.8	91.8	93.1	77.2	78.3	73.9	76.8	69.8
10-72	67.3	79.9	76.0	76.0	66.9	66.0	62.3	66.7	60.4
11-72	48.5	58.0	54.5	55.0	48.0	48.0	45.0	47.5	48.5
12-72	44.0	51.0	47.5	48.5	44.0	43.5	42.5	43.0	44.5
1-73	40.8	45.4	41.5	42.1	40.0	40.0	39.6	40.3	39.7
2-73	39.5	41.2	38.9	39.3	38.8	38.5	37.8	38.8	37.6
3-73	45.3	44.0	43.5	43.4	42.0	42.5	43.5	41.8	43.5
4-73	51.5	48.3	48.5	48.2	45.1	45.5	45.9	45.3	46.2
5-73	53.5	53.2	54.5	54.0	51.3	51.0	50.9	50.3	49.5
6-73	62.5	61.2	63.7	63.0	59.8	58.5	58.8	59.3	59.0
7-73									
8-73	78.0	-	-	-	72.0	68.0	70.0	70.0	70.0
9-73	75.0	79.0	80.0	80.0	70.0	70.0	68.0	-	71.0
10-73	66.0	65.0	62.0	64.0	66.0	65.5	65.0	66.0	62.0
11-73									
12-73	47.0	38.0	47.0	48.0	48.0	-	-	-	-
4-74	54.5	53.0	54.0	53.5	50.5	50.5	52.5	50.0	53.0
5-74	62.4	61.7	-	62.3	57.0	56.6	58.6	56.6	61.3
6-74	70.9	69.0	-	70.3	64.6	65.6	65.6	64.4	69.1
7-74	73.8	71.6	-	74.0	67.6	67.8	68.8	68.0	73.2
8-74	78.1	80.1	-	80.8	72.8	72.9	72.5	71.9	75.3
9-74	75.8	78.5	-	79.3	72.5	71.7	71.0	72.0	70.7
10-74	65.8	71.5	-	70.8	65.3	64.3	63.0	64.5	61.0
11-74	63.0	67.5	-	67.0	62.5	62.0	60.5	61.5	58.5
12-74	45.8	51.5	49.0	49.8	48.0	60.3	47.8	48.0	43.8

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a. All values in degrees Fahrenheit

MEAN MONTHLY TEST CELL TEMPERATURES[a]

Month	Probe Location								
	D1a	D1b	D1c	D1d	A1c	B1c	B1e	C1c	Z1
1-75	44.0	48.3	47.3	47.7	45.7	46.0	45.3	45.7	43.0
2-75	44.7	46.7	46.3	46.3	44.0	44.7	45.3	44.3	45.0
3-75	45.5	47.5	46.5	46.3	44.8	44.5	44.8	44.3	44.3
4-75	52.0	52.2	52.4	51.6	48.4	48.2	49.2	47.4	50.8
5-75	63.7	62.0	64.3	61.7	57.3	57.3	59.3	56.0	65.0
6-75	70.3	68.0	70.7	68.7	66.0	66.0	63.3	63.0	68.3
7-75	77.4	79.4	82.2	79.8	71.0	71.2	71.2	70.0	76.3
8-75	79.3	83.0	85.8	83.0	73.3	73.0	73.0	72.5	77.8
9-75	78.0	83.3	84.5	82.7	74.0	73.0	72.3	73.0	73.0
10-75	68.8	74.8	73.0	73.8	67.4	66.2	65.4	66.6	65.2
11-75	61.0	67.3	65.3	65.5	61.3	60.3	59.5	60.8	56.0
12-75	53.4	58.4	56.6	57.0	54.8	54.2	53.0	54.8	48.0
1-76	42.6	47.8	45.6	46.2	45.0	45.0	44.2	47.2	39.2
2-76	43.3	44.5	43.8	43.3	42.0	42.3	43.3	42.0	42.0
3-76	50.3	53.3	51.0	51.0	48.5	48.3	49.0	47.5	49.3
4-76	56.4	55.6	56.8	56.0	53.0	52.8	53.2	51.4	55.8
5-76	62.8	60.8	61.8	61.8	58.8	58.5	59.0	57.3	63.5
6-76	69.0	67.0	68.7	68.0	65.3	64.0	64.3	62.7	68.0
7-76	76.0	77.0	80.0	78.0	69.5	69.5	69.8	68.5	75.3
8-76	76.0	80.0	82.5	80.0	71.5	71.0	70.0	70.0	74.5
9-76	74.5	77.3	78.3	78.0	72.0	71.0	69.8	70.3	72.0
10-76	65.5	69.0	68.5	68.8	65.8	64.5	63.0	65.0	61.8
11-76	53.3	58.0	55.8	56.5	55.3	54.0	53.5	55.8	48.8
12-76	47.8	53.0	48.8	49.8	49.3	48.5	48.0	49.3	42.8

a. All values in degrees Fahrenheit

MEAN MONTHLY TEST CELL TEMPERATURES[a]

Month	Probe Location								
	D4a	D4b	D4c	D4d	A4c	B4c	B4e	C4c	Z4
8-72	90.1	116.4	113.5	113.8	89.8	87.6	85.2	87.2	67.0
9-72	77.7	101.7	102.0	99.9	74.2	73.8	73.1	73.7	67.1
10-72	71.7	86.0	87.7	85.3	68.0	68.1	64.0	67.3	63.7
11-72	58.0	71.0	71.5	69.5	54.0	58.0	49.5	53.0	55.0
12-72	53.5	65.5	66.5	65.0	50.5	53.5	46.0	50.0	52.0
1-73	48.5	57.0	57.2	55.9	46.2	48.0	41.6	45.9	46.0
2-73	46.2	51.8	51.8	50.9	40.8	44.8	39.6	46.2	45.5
3-73	45.8	49.7	49.5	48.4	43.0	43.7	43.0	43.0	43.8
4-73	50.7	50.2	50.5	49.4	45.4	45.8	45.8	45.8	45.8
5-73	50.5	51.3	51.7	51.0	48.8	47.5	49.6	48.3	49.0
6-73	54.0	53.0	54.0	54.3	53.3	50.8	53.2	53.8	58.5
7-73									
8-73	55.0	54.0	55.0	54.7	54.5	52.0	58.9	55.0	62.5
9-73	68.0	71.0	71.0	73.0	69.0	68.0	68.0	68.0	70.0
10-73	68.5	71.5	71.5	73.0	68.0	68.0	65.5	68.0	63.5
11-73									
12-73	39.0	48.0	42.0	34.0	42.0	-	-	-	-
4-74	51.0	52.5	52.5	52.5	49.0	49.5	50.5	49.0	55.0
5-74	54.7	55.0	55.1	55.0	52.7	52.0	55.9	52.4	60.6
6-74	60.3	58.9	59.0	58.9	59.1	57.4	62.4	58.6	58.9
7-74	63.2	61.2	61.2	61.8	62.2	60.8	65.2	62.0	72.6
8-74	67.6	65.8	65.8	65.9	66.5	64.6	70.1	66.9	74.9
9-74	70.7	69.2	68.5	69.3	69.0	66.7	70.5	68.3	71.2
10-74	67.0	67.8	68.8	69.0	66.3	65.8	63.8	65.8	-
11-74	64.5	68.0	68.0	67.5	64.0	63.5	61.5	63.5	-
12-74	54.3	61.5	61.8	61.3	54.3	56.5	49.5	54.3	-

a. All values in degrees Fahrenheit

MEAN MONTHLY TEST CELL TEMPERATURES[a]

Month	Probe Location								
	D4a	D4b	D4c	D4d	A4c	B4c	B4e	C4c	Z4
1-75	51.7	57.7	52.7	57.7	51.0	52.7	47.0	50.7	-
2-75	49.0	55.3	56.0	55.3	48.0	49.7	46.0	48.3	-
3-75	49.3	54.0	54.5	53.3	46.5	48.5	46.8	48.0	-
4-75	50.4	52.8	53.2	51.8	48.2	48.0	48.4	48.0	-
5-75	54.3	53.7	54.3	53.7	52.3	51.0	56.0	51.7	-
6-75	62.3	57.0	56.7	56.7	57.3	55.7	62.3	56.3	-
7-75	65.4	62.4	62.0	62.8	64.0	63.4	68.2	63.0	-
8-75	68.5	66.7	66.8	67.0	66.3	65.3	70.8	66.8	-
9-75	70.3	70.3	70.0	70.3	69.8	67.8	70.8	68.7	-
10-75	68.0	70.8	70.6	70.8	67.6	66.8	65.8	66.8	-
11-75	64.5	66.8	68.0	67.8	63.8	63.5	60.3	63.3	-
12-75	60.6	65.2	65.8	65.2	60.0	60.8	55.0	59.8	-
1-76	52.2	59.2	59.6	59.4	52.0	54.0	46.7	52.2	-
2-76	48.0	54.8	55.5	54.5	46.8	48.8	44.0	47.3	-
3-76	50.3	53.5	54.3	53.3	48.3	49.0	48.5	48.3	-
4-76	52.8	54.0	54.8	54.4	51.2	51.8	52.2	50.6	-
5-76	57.3	56.3	56.8	56.5	55.5	54.5	57.0	54.5	55.8
6-76	60.0	57.3	57.7	58.3	57.7	56.3	62.3	57.0	60.5
7-76	65.0	62.5	62.3	62.8	63.5	61.3	68.5	62.5	66.0
8-76	66.5	65.5	65.5	65.5	65.6	63.5	68.5	64.5	-
9-76	68.8	68.8	68.5	69.3	68.0	66.3	69.0	67.3	-
10-76	67.0	69.0	68.3	69.0	67.3	66.0	64.8	66.5	-
11-76	61.8	65.3	65.3	65.3	61.5	62.0	56.0	61.0	-
12-76	58.0	61.5	61.8	61.5	56.3	57.3	51.0	55.3	-

[a] All values in degrees Fahrenheit

MEAN MONTHLY TEST CELL TEMPERATURES[a]

Month	Probe Location								
	D7a	D7b	D7c	D7d	A7c	B7c	B7e	C7c	Z7
8-72	75.5	97.8	99.8	99.1	81.4	76.4	73.1	78.5	64.1
9-72	70.1	81.4	84.9	82.0	68.4	68.0	69.0	68.1	63.9
10-72	68.4	73.7	76.4	74.1	65.6	65.4	65.9	65.3	63.2
11-72	59.5	66.5	68.0	66.5	55.5	58.5	57.0	54.5	58.0
12-72	57.5	62.0	65.5	64.5	54.0	55.5	54.0	53.5	56.0
1-73	52.5	59.5	60.4	59.6	50.0	51.4	49.1	49.6	51.0
2-73	49.9	56.2	56.5	56.2	47.3	48.4	45.9	44.6	47.4
3-73	48.0	53.5	54.0	53.4	45.6	46.5	45.0	45.8	45.9
4-73	49.7	52.6	53.2	52.6	47.0	47.2	46.2	47.5	47.0
5-73	50.3	51.9	52.7	52.3	48.2	48.3	48.0	48.5	48.0
6-73	51.5	52.0	51.3	52.4	51.5	50.3	50.8	54.0	-
7-73									
8-73	63.0	63.0	62.0	62.0	68.0	60.0	64.0	68.0	70.0
9-73	64.0	63.0	64.0	64.0	64.0	63.0	65.0	50.0	-
10-73	65.5	67.0	66.5	66.0	65.5	66.0	66.0	65.5	62.5
11-73									
12-73	40.0	47.0	38.0	34.0	43.0	40.0	-	-	-
4-74	51.5	53.0	54.0	54.0	50.5	-	50.0	50.0	-
5-74	53.6	54.3	55.5	55.1	52.6	52.0	52.9	52.6	61.0
6-74	57.3	55.4	56.4	56.4	56.6	-	56.9	56.0	-
7-74	59.0	57.4	57.6	57.6	59.2	-	60.0	58.6	61.0
8-74	61.9	59.9	60.3	60.4	62.5	-	63.3	62.9	-
9-74	64.8	62.7	63.8	62.8	65.3	-	67.0	65.2	-
10-74	64.5	64.5	64.5	64.5	64.8	-	65.0	64.5	-
11-74	63.5	65.0	65.5	65.0	63.5	-	62.5	63.0	-
12-74	57.8	62.3	63.0	62.5	57.5	-	56.8	57.0	-

a. All values in degrees Fahrenheit

MEAN MONTHLY TEST CELL TEMPERATURES[a].

Month	Probe Location								
	D7a	D7b	D7c	D7d	A7c	B7_	B7e	C7c	Z7
1-75	55.0	60.0	60.0	60.0	53.7	-	55.3	53.6	-
2-75	53.0	57.7	58.3	58.0	51.3	-	51.0	51.3	-
3-75	51.75	55.8	57.0	56.8	50.5	-	48.3	50.3	-
4-75	51.6	54.4	55.6	54.6	50.0	-	49.4	50.0	-
5-75	52.3	53.3	54.3	53.3	51.7	-	52.0	51.3	-
6-75	56.3	54.0	54.7	54.0	55.0	-	55.0	54.0	-
7-75	59.4	58.0	57.8	57.2	59.6	-	60.4	59.2	-
8-75	62.8	60.5	60.8	60.5	63.0	-	63.8	62.8	-
9-75	65.0	63.0	63.5	63.0	65.8	-	66.3	65.0	-
10-75	65.0	64.6	65.6	65.2	65.8	-	65.8	64.8	-
11-75	63.8	64.8	65.3	64.8	63.5	-	63.3	63.0	-
12-75	61.6	63.8	64.8	64.4	61.4	-	60.8	60.8	-
1-76	55.8	61.0	61.8	61.6	55.6	-	54.6	55.4	-
2-76	52.3	57.5	58.3	58.3	51.0	-	50.3	51.5	-
3-76	52.3	55.8	56.8	56.5	50.8	-	50.3	50.8	-
4-76	53.4	55.0	56.0	55.8	52.2	-	51.6	51.8	-
5-76	55.0	55.8	56.3	56.3	54.5	-	54.5	54.0	57.0
6-76	56.3	55.7	56.0	55.7	55.3	-	56.3	55.3	63.5
7-76	60.3	57.8	58.0	56.8	59.3	-	60.5	59.3	67.7
8-76	61.5	59.5	59.5	59.5	61.5	-	62.5	61.5	-
9-76	64.0	62.5	63.3	63.0	64.5	-	65.5	64.0	-
10-76	64.8	64.3	65.0	65.0	65.3	-	65.5	64.5	-
11-76	62.5	64.3	64.3	64.5	62.8	-	62.3	61.8	-
12-76	60.0	62.8	63.5	63.3	58.8	-	58.3	58.0	-

a. All values in degrees Fahrenheit